

# Remedial Investigation Report Inland Area Sites 13, 17, 22, 24A, and 27 Naval Weapons Station Concord, California

CLEAN 1

Contract No. N62474-88-D-5006

Contract Task Order No. 0303

Navy Remedial Project Manager: Clint Fisher



October 1997

DRAFT/FINAL





5090  
Ser 10122/8057  
19 Dec 97

From: Commanding Officer, Engineering Field Activity, West, Naval Facilities  
Engineering Command  
To: Distribution

Subj: REMEDIAL INVESTIGATION INLAND AREA SITES 13, 17, 22, 24A, AND 27 NAVAL  
WEAPONS STATION CONCORD DRAFT FINAL REPORT

Ref: (a) Remedial Investigation Inland Area Sites 13, 17, 22, 24A, and 27 Naval Weapons  
Station Concord Draft Final Report  
(b) Federal Facility Site Remediation Agreement (FFSRA) for Concord Naval Weapons  
Station

1. The Draft Final RI Report, reference (a), was provided for agency review on 15 October 1997.  
Having received no comments, the Navy considers the report to be final, in accordance with the  
FFSRA, Section 7.10.

3. If there are any questions regarding this correspondence, please contact the undersigned at (650)  
244-2769.

CLINT FISHER  
By direction

Distribution:

Department of Toxic Substances Control, Sacramento (Attn: James Pinasco)  
Department of Toxic Substances Control, Sacramento (Attn: John Christopher)  
California Regional Water Quality Control Board (Attn: Susan Gladstone)  
U.S. Environmental Protection Agency (Attn: Lynn Suer)  
National Oceanic and Atmospheric Administration (Attn: Laurie Sullivan)  
Department of Fish and Game (Attn: Susan Ellis)  
U.S. Fish and Wildlife Service (Attn: Jim Haas)

Copy to:

TtEMI (Attn: John Bosche)  
NWS Concord (Attn: Stanley Heller)

**COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN I)  
Northern and Central California, Nevada, and Utah  
Contract Number N62474-88-D-5086  
Contract Task Order 0303**

**Prepared For**

**DEPARTMENT OF THE NAVY  
Clint Fisher, Remedial Project Manager  
Engineering Field Activity West  
NAVAL FACILITIES ENGINEERING COMMAND  
San Bruno, California**

**DRAFT FINAL REMEDIAL INVESTIGATION REPORT  
INLAND AREA SITES 13, 17, 22, 24A AND 27  
NAVAL WEAPONS STATION  
CONCORD, CALIFORNIA**

**VOLUME I**

**October 15, 1997**

**Prepared By**

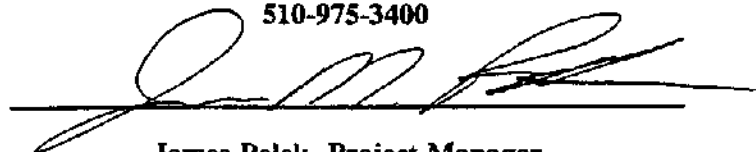
**TETRA TECH EM Inc.  
135 Main Street, Suite 1800  
San Francisco, California 94105  
415-543-4880**



**Anju Vig, Project Manager**

**and**

**MONTGOMERY WATSON  
365 Lennon Lane  
Walnut Creek, California 94598  
510-975-3400**



**James Polek, Project Manager**



## VOLUME I

### CONTENTS

<b><u>Section</u></b>	<b><u>Page</u></b>
EXECUTIVE SUMMARY .....	ES-1
1.0 INTRODUCTION .....	1-1
1.1 PURPOSE OF THE REPORT .....	1-2
1.1.1 The Installation Restoration Program .....	1-2
1.1.2 Federal Facility Agreement .....	1-3
1.1.3 Remedial Investigation Objectives.....	1-4
1.2 FACILITY BACKGROUND .....	1-4
1.2.1 Location.....	1-5
1.2.2 History .....	1-5
1.2.3 Current Operations.....	1-6
1.2.4 Other Environmental Assessments.....	1-7
1.2.5 Storm Water Management.....	1-11
1.3 REMEDIAL INVESTIGATION PROJECT PLANS.....	1-12
1.4 APPROACH TO PRESENTATION OF REMEDIAL INVESTIGATION ANALYTICAL RESULTS.....	1-13
1.5 REPORT ORGANIZATION .....	1-15
2.0 ENVIRONMENTAL SETTING .....	2-1
2.1 LAND USE.....	2-1
2.2 TRANSPORTATION .....	2-2
2.3 CLIMATE.....	2-3
2.4 PHYSIOGRAPHY AND TOPOGRAPHY .....	2-4
2.5 GEOLOGY .....	2-5
2.5.1 Regional Geology .....	2-5
2.5.2 Local Geology.....	2-7
2.6 HYDROLOGY .....	2-8
2.6.1 Regional Hydrology.....	2-8
2.6.2 Local Hydrology .....	2-10
2.7 ECOLOGY CHARACTERIZATION.....	2-11
3.0 INVESTIGATION METHODS .....	3-1
3.1 PERMITS, CLEARANCES, AND SURVEYING .....	3-1
3.2 SURFACE SOIL INVESTIGATION.....	3-2
3.3 SUBSURFACE SOIL INVESTIGATION.....	3-2
3.3.1 Drilled Soil Borings .....	3-3
3.3.2 Trench Excavations.....	3-5

## CONTENTS (Continued)

<u>Section</u>	<u>Page</u>
3.4 GROUNDWATER INVESTIGATION .....	3-6
3.4.1 Monitoring Wells .....	3-6
3.4.2 Groundwater Sampling .....	3-7
3.5 ANALYTICAL PROGRAM .....	3-7
3.5.1 Identification and Documentation of Samples .....	3-7
3.5.2 Sample Analysis, Containerization, and Preservation .....	3-10
3.6 DATA VALIDATION .....	3-10
3.6.1 Validation and Verification Methods .....	3-10
3.6.2 Data Validation Criteria .....	3-13
3.7 QA/QC FIELD PROCEDURES .....	3-13
4.0 PRELIMINARY IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS .....	4-1
4.1 CHEMICAL-SPECIFIC ARARS .....	4-3
4.1.1 Soil .....	4-4
4.1.2 Groundwater .....	4-4
4.2 LOCATION-SPECIFIC ARARs .....	4-4
4.3 ACTION-SPECIFIC ARARs .....	4-5
5.0 RESULTS OF THE RI/FS AT THE BURN AREA (SITE 13) .....	5-1
5.1 PHYSICAL DESCRIPTION AND PAST OPERATIONS .....	5-1
5.2 PHYSICAL CHARACTERISTICS .....	5-2
5.2.1 Physical Setting .....	5-2
5.2.2 Geology .....	5-2
5.2.3 Hydrogeology .....	5-3
5.2.4 Ecological Characterization .....	5-5
5.3 RESULTS OF PREVIOUS INVESTIGATIONS .....	5-7
5.4 REMEDIAL INVESTIGATION FIELD ACTIVITIES .....	5-11
5.4.1 Site Reconnaissance Activities .....	5-12
5.4.2 Trench Excavations .....	5-12
5.4.3 Surface Soil Sampling .....	5-13
5.4.4 Geoprobe Borings .....	5-13
5.4.5 Monitoring Well Soil Borings .....	5-14
5.4.6 Monitoring Well Installation .....	5-14
5.4.7 Groundwater Sampling .....	5-15
5.4.8 Summary of Quality Assurance/Quality Control Field Procedures .....	5-15
5.4.9 Deviations from Proposed Investigation Approach .....	5-15

## CONTENTS (Continued)

<u>Section</u>	<u>Page</u>
5.5	CHEMICAL CHARACTERIZATION ..... 5-16
5.5.1	Results of Soil Sample Analyses ..... 5-16
5.5.2	Results of Groundwater Analyses ..... 5-20
5.5.3	Summary of Chemical Characterization ..... 5-21
5.6	REVISED CONCEPTUAL SITE MODEL ..... 5-23
6.0	RESULTS OF THE RI AT BUILDING IA-24 (SITE 17) ..... 6-1
6.1	PHYSICAL DESCRIPTION AND PAST OPERATIONS ..... 6-1
6.2	PHYSICAL CHARACTERISTICS ..... 6-2
6.2.1	Physical Setting ..... 6-2
6.2.2	Geology ..... 6-3
6.2.3	Hydrogeology ..... 6-3
6.3	RESULTS OF PREVIOUS INVESTIGATIONS ..... 6-4
6.4	REMEDIAL INVESTIGATION FIELD ACTIVITIES ..... 6-7
6.4.1	Utility Locating and Biological/Ecological Clearance ..... 6-7
6.4.2	Surface Soil and Sediment Sampling ..... 6-8
6.4.3	Geoprobe Borings ..... 6-8
6.4.4	Deep Soil Borings ..... 6-9
6.4.5	Monitoring Well Installation ..... 6-9
6.4.6	Groundwater Sampling ..... 6-10
6.4.7	Summary of Quality Assurance/Quality Control Field Procedures ..... 6-10
6.4.8	Deviations from Proposed Investigation Approach ..... 6-10
6.5	CHEMICAL CHARACTERIZATION ..... 6-10
6.5.1	Results of Soil and Sediment Sample Analyses ..... 6-11
6.5.2	Results of Groundwater Analyses ..... 6-16
6.5.3	Summary of Chemical Characterization ..... 6-17
6.6	REVISED CONCEPTUAL SITE MODEL ..... 6-19
7.0	RESULTS OF THE RI/FS AT BUILDING 7SH5 (SITE 22) ..... 7-1
7.1	PHYSICAL DESCRIPTION AND PAST OPERATIONS ..... 7-1
7.2	PHYSICAL CHARACTERISTICS ..... 7-2
7.2.1	Physical Setting ..... 7-2
7.2.2	Geology ..... 7-2
7.2.3	Hydrogeology ..... 7-3
7.3	RESULTS OF PREVIOUS INVESTIGATIONS ..... 7-3

## CONTENTS (Continued)

<u>Section</u>		<u>Page</u>
7.4	REMEDIAL INVESTIGATION FIELD ACTIVITIES .....	7-5
7.4.1	Utility Locating and Geophysical Survey .....	7-5
7.4.2	Pit Excavation .....	7-6
7.4.3	Surface Soil Sampling .....	7-6
7.4.4	Geoprobe Borings .....	7-6
7.4.5	Subsurface Borings .....	7-7
7.4.6	Groundwater Sampling .....	7-8
7.4.7	Summary of Quality Assurance/Quality Control Field Procedures .....	7-8
7.4.8	Deviations from Proposed Investigation Approach .....	7-8
7.5	CHEMICAL CHARACTERIZATION .....	7-9
7.5.1	Results of Soil Sample Analyses .....	7-9
7.5.2	Results of Groundwater Analyses .....	7-12
7.5.3	Summary of Chemical Characterization .....	7-13
7.6	REVISED CONCEPTUAL SITE MODEL .....	7-14
8.0	RESULTS OF THE REMEDIAL INVESTIGATION AT THE PISTOL FIRING RANGE (SITE 24A) .....	8-1
8.1	PHYSICAL DESCRIPTION AND PAST OPERATIONS .....	8-1
8.2	PHYSICAL CHARACTERISTICS .....	8-1
8.2.1	Physical Setting .....	8-2
8.2.2	Geology .....	8-2
8.3	RESULTS OF PREVIOUS INVESTIGATIONS .....	8-3
8.4	REMEDIAL INVESTIGATION FIELD SAMPLING .....	8-4
8.4.1	Site Reconnaissance Activities .....	8-5
8.4.2	Surface Soil Sampling .....	8-5
8.4.3	Geoprobe Borings .....	8-6
8.4.4	Summary of Quality Assurance/Quality Control Field Procedures .....	8-6
8.4.5	Deviations from Proposed Investigation Approach .....	8-6
8.5	CHEMICAL CHARACTERIZATION .....	8-7
8.5.1	Results of Soil Sample Analyses .....	8-7
8.5.2	Summary of Chemical Characterization .....	8-10
8.6	REVISED CONCEPTUAL SITE MODEL .....	8-11
9.0	RESULTS OF THE RI/FS AT BUILDING 1A-20 (SITE 27) .....	9-1
9.1	PHYSICAL DESCRIPTION AND PAST OPERATIONS .....	9-1
9.2	PHYSICAL CHARACTERISTICS .....	9-2

# CONTENTS (Continued)

<u>Section</u>		<u>Page</u>
	9.2.1 Physical Setting.....	9-2
	9.2.2 Geology.....	9-2
9.3	RESULTS OF PREVIOUS INVESTIGATIONS.....	9-2
9.4	REMEDIAL INVESTIGATION FIELD ACTIVITIES.....	9-4
	9.4.1 Site Reconnaissance Activities.....	9-5
	9.4.2 Surface Soil Sampling.....	9-5
	9.4.3 Geoprobe Borings.....	9-6
	9.4.4 Summary of Quality Assurance/Quality Control Field Procedures.....	9-6
	9.4.5 Deviations from Proposed Investigation Approach.....	9-6
9.5	CHEMICAL CHARACTERIZATION.....	9-6
	9.5.1 VOCs and SVOCs.....	9-7
	9.5.2 Pesticides and PCBs.....	9-7
	9.5.3 TPH Constituents.....	9-8
	9.5.4 Summary of Chemical Characterization.....	9-9
9.6	REVISED CONCEPTUAL SITE MODEL.....	9-10
10.0	HUMAN HEALTH RISK ASSESSMENT.....	10-1
10.1	DATA EVALUATION.....	10-1
	10.1.1 HHRA Data.....	10-2
	10.1.2 Data Evaluation.....	10-3
	10.1.3 Identification of Chemicals of Potential Concern in Soil.....	10-4
	10.1.4 Identification of Chemicals of Potential Concern in Other Media.....	10-6
10.2	EXPOSURE ASSESSMENT.....	10-7
	10.2.1 Exposure Setting and Land Use.....	10-7
	10.2.2 Receptors and Exposure Pathways.....	10-7
	10.2.3 Exposure Point Concentrations.....	10-10
10.3	TOXICITY ASSESSMENT.....	10-11
	10.3.1 Toxicity Values.....	10-11
	10.3.2 Chemicals with no Toxicity Values.....	10-12
10.4	RISK CHARACTERIZATION.....	10-13
	10.4.1 Risk Characterization Methodology.....	10-13
	10.4.2 Risk and Hazard Estimates.....	10-15
	10.4.3 Soil Screening Level Comparison.....	10-22
	10.4.4 Uncertainty Associated with the Risk Assessment.....	10-24
11.0	QUALITATIVE ECOLOGICAL RISK ASSESSMENT.....	11-1

## CONTENTS (Continued)

<u>Section</u>	<u>Page</u>
11.1	ECOLOGICAL RISK ASSESSMENT APPROACH ..... 11-1
11.1.1	The Framework Approach ..... 11-1
11.1.2	Problem Formulation ..... 11-2
11.1.3	Exposure Assessment ..... 11-3
11.1.4	Effects Assessment ..... 11-3
11.1.5	Risk Characterization ..... 11-4
11.1.6	Overview of the ERA Approach for the Inland Area ..... 11-4
11.2	INLAND AREA PROBLEM FORMULATION AND SITE CHARACTERIZATION ..... 11-4
11.2.1	Description of Sites in the Inland Area ..... 11-5
11.2.2	Methods of Screening Chemicals ..... 11-12
11.2.3	Nature and Extent of Contamination ..... 11-17
11.2.4	Ecological Characterization ..... 11-33
11.2.5	Conceptual Site Model - Burn Area ..... 11-38
11.3	EXPOSURE ASSESSMENT ..... 11-42
11.3.1	Complete Exposure Pathways ..... 11-42
11.3.2	Measures of Bioavailability ..... 11-42
11.3.3	Food Chain Modeling Approach Using Estimates of Prey Concentrations ..... 11-45
11.4	ECOLOGICAL EFFECTS ASSESSMENT - SITE 13 ..... 11-50
11.4.1	Effects on Plants ..... 11-50
11.4.2	Effects on Invertebrates ..... 11-56
11.4.3	Effects on Vertebrates (Birds and Mammals) ..... 11-57
11.4.4	Toxicity Reference Values (TRV) ..... 11-57
11.4.5	Hazard Quotients for Birds and Mammals ..... 11-58
11.5	RISK CHARACTERIZATION AND CONCLUSIONS ..... 11-59
11.5.1	Data Limitations and Sources of Uncertainty ..... 11-60
11.5.2	Risk Characterization Summary - Site 13 (Burn Area) ..... 11-62
11.5.3	Risk Characterization Summary - Site 17 (Seal Creek) ..... 11-63
12.0	CONTAMINANT FATE AND TRANSPORT ..... 12-1
12.1	PHYSICAL AND CHEMICAL PROCESSES AFFECTING FATE AND TRANSPORT ..... 12-2
12.1.1	Volatilization ..... 12-2
12.1.2	Advection ..... 12-3
12.1.3	Dispersion and Molecular Diffusion ..... 12-3
12.1.4	Nonaqueous-Phase Liquid Transport ..... 12-4
12.1.5	Water Solubility ..... 12-5
12.1.6	Sorption/Desorption ..... 12-5

## CONTENTS (Continued)

<u>Section</u>	<u>Page</u>
12.1.7 Hydrolysis .....	12-6
12.1.8 Oxidation/Reduction .....	12-6
12.1.9 Precipitation and Dissolution .....	12-6
12.1.10 Biological Processes .....	12-7
12.2 PERSISTENCE OF ORGANIC CHEMICALS OF CONCERN .....	12-7
12.3 PERSISTENCE OF INORGANIC CHEMICALS OF CONCERN .....	12-8
12.4 SITE-SPECIFIC FATE AND TRANSPORT .....	12-9
13.0 SUMMARY AND RECOMMENDATIONS .....	13-1
13.1 SITE 13 - BURN AREA .....	13-1
13.1.1 Site 13 - Chemical Characterization .....	13-1
13.1.2 Site 13 - HHRA .....	13-2
13.1.3 Site 13 - ERA .....	13-3
13.1.4 Site 13 - Contaminant Fate and Transport .....	13-5
13.1.5 Site 13 - Recommendations .....	13-6
13.2 SITE 17 - BUILDING IA-24 .....	13-6
13.2.1 Site 17 - Chemical Characterization .....	13-7
13.2.2 Site 17 - HHRA .....	13-8
13.2.3 Site 17 - ERA .....	13-9
13.2.4 Site 17 - Contaminant Fate and Transport .....	13-10
13.2.5 Site 17 - Recommendations .....	13-11
13.3 SITE 22 - BUILDING 7SH5 .....	13-12
13.3.1 Site 22 - Chemical Characterization .....	13-12
13.3.2 Site 22 - HHRA .....	13-13
13.3.3 Site 22 - Contaminant Fate and Transport .....	13-14
13.3.4 Site 22 - Recommendations .....	13-15
13.4 SITE 24A - PISTOL FIRING RANGE .....	13-16
13.4.1 Site 24A - Chemical Characterization .....	13-16
13.4.2 Site 24A - HHRA .....	13-17
13.4.3 Site 24A - Contaminant Fate and Transport .....	13-18
13.4.4 Site 24A - Recommendations .....	13-18
13.5 SITE 27 - BUILDING IA-20 .....	13-19
13.5.1 Site 27 - Chemical Characterization .....	13-19
13.5.2 Site 27 - HHRA .....	13-20
13.5.3 Site 27 - Contaminant Fate and Transport .....	13-21
13.5.4 Site 27 - Recommendations .....	13-21
REFERENCES .....	R-1

## CONTENTS (Continued)

### Section

### Page

## VOLUME II

### APPENDICES

A - Ambient Metals Evaluation	
B - Soil Boring Logs	
C - Trench Excavation Logs	
D - Geotechnical Testing Results	
E - Groundwater Sampling Forms	
F - Site 13 Unexploded Ordnance Report	
G - Well Construction Diagrams	
H - Well Development Data	
I - Quality Control Summary Report	
J - Remedial Investigation Analytical Results	
K - Calculation of Exposure Point Concentrations and Statistical Summaries	
L - EPA Region IX Preliminary Remediation Goals	
M - Toxicity Profiles	
N - Chemical-Specific and Total Cancer Risk and Hazard Index Tables	
O - Summary Statistics for Microtox and Comprehensive Soil Analysis at Concord Inland Burn Area	
P - Ecological Effects of Chemicals of Ecological Concern	



## FIGURES

### Figure

- 1-1 REGIONAL LOCATION MAP
- 1-2 TIDAL AND INLAND AREAS
- 1-3 INLAND AREA RI SITES
  
- 2-1 LAND USE AND TRANSPORTATION IN THE VICINITY OF THE NWS CONCORD
- 2-2 LAND USE OF NWS CONCORD INLAND AREA
- 2-3 PHYSIOGRAPHY AND TOPOGRAPHY OF INLAND AREA
- 2-4 GEOLOGY OF NWS CONCORD AND CONCEPTUAL HYDROGEOLOGIC CROSS SECTION A-A'
- 2-5 CONCEPTUAL HYDROGEOLOGIC CROSS SECTION B-B'
  
- 5-1 SITE 13 - BURN AREA SITE FEATURES
- 5-2 SITE 13 - GEOLOGIC CROSS SECTION LINES
- 5-3 SITE 13 - HYDROGEOLOGIC CROSS-SECTION C - C'
- 5-4 SITE 13 - HYDROGEOLOGIC CROSS-SECTION D - D'
- 5-5 SITE 13 - HYDROGEOLOGIC CROSS-SECTION E - E'
- 5-6 SITE 13 - INTERPRETATIVE GROUNDWATER CONTOURS, JUNE 1995
- 5-7 SITE 13 - INTERPRETATIVE GROUNDWATER CONTOURS, SEPTEMBER 1995
- 5-8 SITE 13 - SITE INVESTIGATION SAMPLING LOCATIONS
- 5-9 ORGANIC CONSTITUENTS DETECTED DURING THE SI AT SITE 13 IN SOIL
- 5-10 INORGANIC CONSTITUENTS DETECTED DURING THE SI AT SITE 13 IN SOIL
- 5-11 SITE 13 - REMEDIAL INVESTIGATION SAMPLING LOCATIONS
- 5-12 ORGANIC CONSTITUENTS DETECTED DURING THE RI AT SITE 13 IN SOIL
- 5-13 INORGANIC CONSTITUENTS DETECTED DURING THE RI AT SITE 13 IN SOIL
- 5-14 SITE 13 - DELINEATION OF ELEVATED LEAD CONCENTRATIONS
- 5-15 ORGANIC CONSTITUENTS DETECTED DURING THE RI AT SITE 13 IN GROUNDWATER
- 5-16 SITE 13 - REVISED CONCEPTUAL MODEL
  
- 6-1 SITE 17 - BUILDING 1A-24 SITE FEATURES
- 6-2 SITE 17 - GEOLOGIC CROSS SECTION LINES
- 6-3 SITE 17 - HYDROGEOLOGIC CROSS SECTION F - F'
- 6-4 SITE 17 - HYDROGEOLOGIC CROSS SECTION G - G'
- 6-5 SITE 17 - INTERPRETATIVE GROUNDWATER CONTOURS, MAY 1995
- 6-6 SITE 17 - INTERPRETATIVE GROUNDWATER CONTOURS, SEPTEMBER 1995
- 6-7 SITE 17 - SITE INVESTIGATION SAMPLING LOCATIONS
- 6-8 ORGANIC CONSTITUENTS DETECTED DURING THE SI AT SITE 17 IN SOIL
- 6-9 INORGANIC CONSTITUENTS DETECTED DURING THE SI AT SITE 17 IN SOIL
- 6-10 SITE 17 - REMEDIAL INVESTIGATION SAMPLING LOCATIONS
- 6-11 ORGANIC CONSTITUENTS DETECTED DURING THE RI AT SITE 17 IN SOIL
- 6-12 INORGANIC CONSTITUENTS DETECTED DURING THE RI AT SITE 17 IN SOIL
- 6-13 ORGANIC CONSTITUENTS DETECTED DURING THE RI AT SITE 17 IN GROUNDWATER
- 6-14 SITE 17 - REVISED CONCEPTUAL MODEL
  
- 7-1 SITE 22 - BUILDING 7SH5 SITE FEATURES
- 7-2 SITE 22 - GEOLOGIC CROSS SECTION LINE AND INTERPRETATIVE GROUNDWATER CONTOURS, MAY 1995
- 7-3 SITE 22 - HYDROGEOLOGIC CROSS SECTION H-H'
- 7-4 SITE 22 - SITE INVESTIGATION SAMPLING LOCATIONS
- 7-5 ORGANIC CONSTITUENTS DETECTED DURING THE SI AT SITE 22 IN SOIL
- 7-6 INORGANIC CONSTITUENTS DETECTED DURING THE SI AT SITE 22 IN SOIL
- 7-7 SITE 22 - REMEDIAL INVESTIGATION SAMPLING LOCATIONS
- 7-8 ORGANIC CONSTITUENTS DETECTED DURING THE RI AT SITE 22 IN SOIL

**FIGURES**  
**(Continued)**

**Figure**

- 7-9 INORGANIC CONSTITUENTS DETECTED DURING THE RI AT SITE 22 IN SOIL
- 7-10 ORGANIC CONSTITUENTS DETECTED DURING THE RI AT SITE 22 IN GROUNDWATER
- 7-11 SITE 22 - REVISED CONCEPTUAL MODEL
  
- 8-1 SITE 24A - PISTOL FIRING RANGE SITE FEATURES
- 8-2 SITE 24A - SITE INVESTIGATION SAMPLING LOCATIONS
- 8-3 INORGANIC CONSTITUENTS DETECTED DURING THE SI AT SITE 24A IN SOIL
- 8-4 SITE 24A - REMEDIAL INVESTIGATION SAMPLING LOCATIONS
- 8-5 ORGANIC AND INORGANIC CONSTITUENTS DETECTED DURING THE RI AT SITE 24A  
IN SOIL
- 8-6 SITE 24A - REVISED CONCEPTUAL MODEL
  
- 9-1 SITE 27 - BUILDING IA-20 SITE FEATURES
- 9-2 SITE 27 - SITE INVESTIGATION SAMPLING LOCATIONS
- 9-3 ORGANIC CONSTITUENTS DETECTED DURING THE SI AT SITE 27 IN SOIL
- 9-4 SITE 27 - REMEDIAL INVESTIGATION SAMPLING LOCATIONS
- 9-5 ORGANIC CONSTITUENTS DETECTED DURING THE RI AT SITE 27 IN SOIL
- 9-6 SITE 27 - REVISED CONCEPTUAL MODEL
  
- 10-1 GENERAL CONCEPTUAL MODEL
  
- 11-1 SOURCES OF INFORMATION THAT CONTRIBUTE TO AN ECOLOGICAL RISK  
ASSESSMENT
- 11-2 DATA SELECTION AND ANALYSIS PROCESS FOR SOIL CONTAMINATION  
EVALUATION AT SITE 13 - BURN AREA

## TABLES

### Table

3-1	SAMPLE CONTAINER, HOLDING TIMES, AND PRESERVATIVE REQUIREMENTS FOR SOIL SAMPLES
3-2	SAMPLE CONTAINER, HOLDING TIMES, AND PRESERVATIVE REQUIREMENTS FOR WATER SAMPLES
3-3	ANALYTICAL METHODS FOR SOIL SAMPLES
3-4	ANALYTICAL METHODS FOR WATER SAMPLES
4-1	PRELIMINARY IDENTIFICATION OF FEDERAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS, INLAND AREA SITES, NAVAL WEAPONS STATION CONCORD
5-1	SUMMARY OF GEOTECHNICAL TESTING RESULTS AT SITE 13 BURN AREA
5-2	SUMMARY OF REMEDIAL INVESTIGATION SOIL ANALYSES AT SITE 13
5-3	SUMMARY OF REMEDIAL INVESTIGATION GROUNDWATER ANALYSES AT SITE 13
5-4	SUMMARY OF DETECTED VOCs IN REMEDIAL INVESTIGATION SOIL SAMPLES AT SITE 13
5-5	SUMMARY OF DETECTED SVOCs IN REMEDIAL INVESTIGATION SOIL SAMPLES AT SITE 13
5-6	SUMMARY OF DETECTED TPH IN REMEDIAL INVESTIGATION SOIL SAMPLES AT SITE 13
5-7	SUMMARY OF DETECTED METALS IN REMEDIAL INVESTIGATION SOIL SAMPLES AT SITE 13
5-8	SUMMARY OF DETECTED ORGANICS IN REMEDIAL INVESTIGATION GROUNDWATER SAMPLES AT SITE 13
5-9	SUMMARY OF DETECTED METALS IN REMEDIAL INVESTIGATION GROUNDWATER SAMPLES AT SITE 13
6-1	SUMMARY OF GEOTECHNICAL TESTING RESULTS AT SITE 17 BUILDING IA-24
6-2	SUMMARY OF REMEDIAL INVESTIGATION SOIL AND SEDIMENT ANALYSES AT SITE 17
6-3	SUMMARY OF REMEDIAL INVESTIGATION GROUNDWATER ANALYSES AT SITE 17
6-4	SUMMARY OF DETECTED VOCs IN REMEDIAL INVESTIGATION SOIL AND SEDIMENT SAMPLES AT SITE 17
6-5	SUMMARY OF DETECTED SVOCs IN REMEDIAL INVESTIGATION SOIL AND SEDIMENT SAMPLES AT SITE 17
6-6	SUMMARY OF DETECTED TPH IN REMEDIAL INVESTIGATION SOIL AND SEDIMENT SAMPLES AT SITE 17
6-7	SUMMARY OF DETECTED METALS IN REMEDIAL INVESTIGATION SOIL AND SEDIMENT SAMPLES AT SITE 17
6-8	SUMMARY OF DETECTED ORGANICS IN REMEDIAL INVESTIGATION GROUNDWATER SAMPLES AT SITE 17
6-9	SUMMARY OF DETECTED METALS IN REMEDIAL INVESTIGATION GROUNDWATER SAMPLES AT SITE 17
7-1	SUMMARY OF GEOTECHNICAL TESTING RESULTS AT SITE 22 BUILDING 7SH5
7-2	SUMMARY OF REMEDIAL INVESTIGATION SOIL ANALYSES AT SITE 22
7-3	SUMMARY OF REMEDIAL INVESTIGATION GROUNDWATER ANALYSES AT SITE 22
7-4	SUMMARY OF DETECTED VOCs IN REMEDIAL INVESTIGATION SOIL SAMPLES AT SITE 22
7-5	SUMMARY OF DETECTED SVOCs IN REMEDIAL INVESTIGATION SOIL SAMPLES AT SITE 22
7-6	SUMMARY OF DETECTED TPH IN REMEDIAL INVESTIGATION SOIL SAMPLES AT

**TABLES**  
**(Continued)**

**Table**

SITE 22

**TABLES**  
**(Continued)**

**Table**

7-7	SUMMARY OF DETECTED METALS IN REMEDIAL INVESTIGATION SOIL SAMPLES AT SITE 22
7-8	SUMMARY OF DETECTED ORGANICS IN REMEDIAL INVESTIGATION GROUNDWATER SAMPLES AT SITE 22
8-1	SUMMARY OF GEOTECHNICAL TESTING RESULTS AT SITE 24A PISTOL FIRING RANGE
8-2	SUMMARY OF REMEDIAL INVESTIGATION SOIL ANALYSES AT SITE 24A
8-3	SUMMARY OF DETECTED SVOCs IN REMEDIAL INVESTIGATION SOIL SAMPLES AT SITE 24A
8-4	SUMMARY OF DETECTED METALS IN REMEDIAL INVESTIGATION SOIL SAMPLES AT SITE 24A
9-1	SUMMARY OF GEOTECHNICAL TESTING RESULTS AT SITE 27 BUILDING IA-20
9-2	SUMMARY OF REMEDIAL INVESTIGATION SOIL ANALYSES AT SITE 27
9-3	SUMMARY OF DETECTED SVOCs IN REMEDIAL INVESTIGATION SOIL SAMPLES AT SITE 27
9-4	SUMMARY OF DETECTED PESTICIDES AND PCBS IN REMEDIAL INVESTIGATION SOIL SAMPLES AT SITE 27
9-5	SUMMARY OF DETECTED TPH IN REMEDIAL INVESTIGATION SOIL SAMPLES AT SITE 27
10-1	SITE 13 - BURN AREA, SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS, INDUSTRIAL SCENARIO
10-2	SITE 13 - BURN AREA, SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS, RESIDENTIAL SCENARIO
10-3	SITE 17 - BUILDING IA-24, SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS, INDUSTRIAL SCENARIO
10-4	SITE 17 - BUILDING IA-24, SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS, RESIDENTIAL SCENARIO
10-5	SITE 22 - BUILDING 7SH5, SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS, INDUSTRIAL SCENARIO
10-6	SITE 22 - BUILDING 7SH5, SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS, RESIDENTIAL SCENARIO
10-7	SITE 24A - PISTOL FIRING RANGE, SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS, INDUSTRIAL SCENARIO
10-8	SITE 24A - PISTOL FIRING RANGE, SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS, RESIDENTIAL SCENARIO
10-9	SITE 27 - BUILDING IA-20, SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS, INDUSTRIAL SCENARIO
10-10	SITE 27 - BUILDING IA-20, SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS, RESIDENTIAL SCENARIO
10-11	SUMMARY OF CANCER RISK AND HAZARD INDEX FOR INDUSTRIAL EXPOSURE TO AMBIENT LEVELS AT SITE 13 AND SITE 22
10-12	SUMMARY OF CANCER RISK AND HAZARD INDEX FOR RESIDENTIAL EXPOSURE TO AMBIENT LEVELS AT SITE 13 AND SITE 22
10-13	SUMMARY OF CANCER RISK AND HAZARD INDEX FOR INDUSTRIAL EXPOSURE TO AMBIENT LEVELS AT SITE 17 AND SITE 24A
10-14	SUMMARY OF CANCER RISK AND HAZARD INDEX FOR RESIDENTIAL EXPOSURE TO AMBIENT LEVELS AT SITE 17 AND SITE 24A
10-15	CHEMICALS OF POTENTIAL CONCERN THAT EXCEED SOIL SCREENING LEVELS

**TABLES**  
**(Continued)**

**Table**

11-1	COECS AT BURN AREA
11-2	SITE 17 STATISTICAL SUMMARY OF SEDIMENT ANALYTICAL RESULTS
11-3	STATISTICAL SUMMARY OF SOIL AND SEDIMENT SAMPLE LEACHABILITY TEST RESULTS USING WET-DI METHOD AT SITES 13 AND 17
11-4	TERRESTRIAL PLANT SPECIES OCCURRING AT BURN AREA
11-5	TOTAL METALS ON BULK SOILS AND WET METALS: SUMMARY STATISTICS FOR TARGET ANALYTES AT ALL SAMPLE LOCATIONS FOR THE BURN AREA
11-6	TOTAL METALS ON BULK SOILS AND WET METALS: SUMMARY STATISTICS FOR SUBSET EVALUATED FOR SOIL SUITABILITY AND TESTED USING MICROTOX
11-7	SUMMARY RESULTS: MICROTOX AND COMPREHENSIVE SOIL SURVEY FROM BURN AREA
11-8	SUMMARY MATRICES FOR MOST SIGNIFICANT CORRELATIONS AMONGST SELECTED VARIABLES IDENTIFIED FOR THE BURN AREA (PEARSON CORRELATION)
11-9	SUMMARY MATRICES FOR MOST SIGNIFICANT CORRELATIONS AMONGST SELECTED VARIABLES IDENTIFIED FOR THE BURN AREA (SPEARMAN CORRELATION)
11-10	SUMMARY OF CONCENTRATIONS OF PLANT NUTRIENTS IN WESTERN SOILS TO SUPPORT INTERPRETATION OF COMPREHENSIVE SOIL ANALYSIS FOR THE BURN AREA
11-11	LIST OF CRITICAL RECEPTORS FOR BURN AREA
11-12	LIST OF COECS FOR BURN AREA AND LITERATURE ESTIMATES FOR NOAELS
11-13	COECS FOR THE BURN AREA AND AVAILABLE TRVS DEVELOPED FOR SAN FRANCISCO BAY AREA
11-14	LITERATURE-DERIVED PLANT:SOIL RATIOS FOR COECS
11-15	EXPOSURE PARAMETERS FOR TERRESTRIAL RECEPTORS
11-16	CUMULATIVE DAILY DOSE ESTIMATES FOR SELECTED COECS AND INDICATOR SPECIES AT THE BURN AREA
11-17	RANGE OF HAZARD QUOTIENTS (HQs) DERIVED FROM NOAELS AND ESTIMATED DAILY DOSES FOR SELECTED COECS AND CRITICAL RECEPTORS
11-18	RANGE OF HAZARD QUOTIENTS (HQs) DERIVED FROM AVAILABLE BENCHMARK TRVS AND ESTIMATED DAILY DOSES FOR SELECTED COECS AND CRITICAL RECEPTORS
11-19	SCREENING GUIDANCE VALUES FOR SOIL AND LITTER ORGANISMS AND HETEROTROPHIC PROCESSES AND TERRESTRIAL PLANTS
11-20	POTENTIAL CRITICAL VALUES FOR SELECTED SOIL FACTORS (PHYSICAL AND CHEMICAL) THAT MAY BE ASSOCIATED WITH POOR VEGETATIVE GROWTH
11-21	COMPILATION OF BURN AREA MAXIMUM SOIL CONCENTRATIONS DERIVED FROM RI AND GUIDANCE VALUES FOR EVALUATING SOIL CONTAMINATION FOR ASSESSMENT, MONITORING, AND REMEDIATION PURPOSES
12-1	CHEMICALS OF CONCERN
12-2	PHYSICAL-CHEMICAL PROPERTIES OF POTENTIAL SITE-RELATED ORGANIC CHEMICALS OF CONCERN
12-3	PERSISTENCY OF ORGANIC CHEMICALS OF CONCERN
12-4	MOBILITY AND PERSISTENCE FACTOR CLASSES
12-5	MOBILITY AND PERSISTENCE FACTOR CLASSES FOR CHEMICALS OF CONCERN

## ABBREVIATIONS AND ACRONYMS

80/95 LCL	80 percent lower confidence limit on the 95 percentile
95/95 TI	95%/95% Tolerance Interval
95 UCL	95 percent upper confidence limit
AA	Atomic Absorption Spectroscopy
AE	Auxiliary Explosives
AG	Anderson Geotechnical Consultants
APHA	American Public Health Association
AM/3SD	Arithmetic Mean plus Three Standard Deviations
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society for Testing and Materials
atm-m <sup>3</sup> /mol	Atmosphere-Cubic Meter per Mole
B&C	Brown and Caldwell Consulting Engineers
bgs	Below Ground Surface
BMP	Best Management Practices
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
Cal-EPA	California Environmental Protection Agency
CAS	Chemical Abstract Service
CCCWD	Contra Costa County Water District
CCR	California Code of Regulations
CDD	chlorodibenzo-p-dioxin
CDF	chlorodibenzofuran
CDWR	California Department of Water Resources
CEC	Cation Exchange Capacity
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
cfs	Cubic Feet per Second
CLEAN	Comprehensive Long-term Environmental Action Navy
CLP	Contract Laboratory Program
cm/sec	Centimeters per Second
COC	Chemical of Concern
COEC	Chemical of Ecological Concern
COPC	Chemical of Potential Concern
CRP	Community Relations Plan
CS	Confirmation Study
CSM	Conceptual Site Model
CSWRCB	California State Water Resources Control Board
CWA	Clean Water Act
CTO	Contract Task Order
DAF	Dilution-Attenuation Factor
DERP	Defense Environmental Restoration Program
DL	Detection Limit
DMG	Division of Mines and Geology
DNAPL	Dense Nonaqueous Phase Liquid
DoD	Department of Defense
DQO	Data Quality Objective
DTSC	California Department of Toxic Substances Control
E&E	Ecology and Environment, Inc.
ECD	Electron Capture Detector
ERA	Ecological Risk Assessment
EFA WEST	Engineering Field Activity West
EOD	Explosive Ordnance Disposal
EPA	U.S. Environmental Protection Agency

## ABBREVIATIONS AND ACRONYMS (Continued)

EPC	Exposure Point Concentration
ERL	Effects Range-Low
ERM	Effects Range-Median
FFA	Federal Facilities Agreement
FFSRA	Federal Facility Site Remediation Agreement
FID	Flame Ionization Detector
$f_{oc}$	Fraction of Organic Carbon
FS	Feasibility Study
FSP	Field Sampling Plan
GC	Gas Chromatography
GC/ECD	Gas Chromatography/Electron Capture Detector
GC/FID	Gas Chromatography/Flame Ionization Detector
GC/MS	Gas Chromatography/Mass Spectrometry
GC/SIM	Gas Chromatography/Selective Ion Monitoring
GTI	Groundwater Technology, Inc.
HAZWRAP	Hazardous Waste Remedial Action Program
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HI	Hazard Index
HLA	Harding Lawson Associates
HQ	Hazard Quotient
HRS	Hazard Ranking System
HSP	Health and Safety Plan
IAS	Initial Assessment Study
ICP	Inductively Coupled Plasma Emission Spectroscopy
ICS	Interference Check Sample
ID	Inside Diameter
IDW	Investigation-Derived Waste
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
IT Corp.	International Technology Corporation
JMM	James M. Montgomery, Inc.
$K_D$	Partition Coefficient
kg/day	Kilograms per Day
$k_{oc}$	Organic Carbon Partition Coefficient
$k_{ow}$	Octanol Water Partition Coefficient
LNAPL	Light Nonaqueous Phase Liquid
LOAEL	Lowest-Observable-Adverse-Effect Level
LUFT	Leaking Underground Fuel Tank
L/day	Liters per Day
Fg/kg	Micrograms per Kilogram
Fg/L	Micrograms per Liter
MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goal
meq/100g	Milliequivalent per 100 Grams
mg/kg	Milligrams per Kilogram
mg/kg/day	Milligrams per Kilogram per Day
mg/L	Milligrams per Liter
mm/Hg	Millimeters of Mercury
mph	Miles per Hour
MK	Mark
MS	Mass Spectrometry
MS/MSD	Matrix Spike/Matrix Spike Duplicate



## ABBREVIATIONS AND ACRONYMS (Continued)

msl	Mean Sea Level
NACIP	Naval Assessment and Control of Installation Pollutants
NAPL	Nonaqueous Phase Liquid
NAVSEA	Commander, Naval Seas Systems Command
NCP	National Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
NFEC	Navy Facilities Engineering Command
NFRAP	No Further Response Action Plan
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No-Observable-Adverse-Effects Level
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NWS	Naval Weapons Station
OC	Organochlorine
PA	Preliminary Assessment
PAH	Polynuclear Aromatic Hydrocarbon
PARCC	Precision, Accuracy, Representativeness, Comparability, and Completeness
PCB	Polychlorinated Biphenyls
PCE	Tetrachloroethene
PCP	Pentachlorophenol
PID	Photoionization Detector
POL	Petroleum, Oil, and Lubricants
POTW	Publicly Owned Treatment Works
ppm	Parts per Million
PRC	PRC Environmental Management, Inc.
PRG	Preliminary Remediation Goals
PVC	Polyvinyl Chloride
PWD	Public Works Department
QA/QC	Quality Assurance/Quality Control
QAPjP	Quality Assurance Project Plan
QCSR	Quality Control Summary Report
RAB	Restoration Advisory Board
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
RWQCB	San Francisco Bay Regional Water Quality Control Board
SARA	Superfund Amendments and Reauthorization Act
SDG	Sample Delivery Group
SERVON	Service Squadron
SF	Slope Factor
SI	Site Investigation
SIM	Selective Ion Monitoring
SOP	Standard Operating Procedure
SQL	Sample Quantitation Limit
SSL	Soil Screening Level
STLC	Soluble Threshold Limit Concentration
SVOA	Semivolatile Organic Analysis
SVOC	Semivolatile Organic Compounds
SWMU	Solid Waste Management Unit
SWPP	Storm Water Pollution Prevention

## ABBREVIATIONS AND ACRONYMS (Continued)

TBC	To Be Considered
TBT	Tributyltin
TCA	Tetrachloroethane
TCE	Trichloroethene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leaching Procedure
TDS	Total Dissolved Solids
TIC	Tentatively Identified Compound
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TPH-D	Total Petroleum Hydrocarbons as Diesel
TPH-E	Total Petroleum Hydrocarbons as Extractables
TPH-G	Total Petroleum Hydrocarbons as Gasoline
TPH-P	Total Petroleum Hydrocarbons as Petroleum
TSS	Total Suspended Solids
TTLC	Total Threshold Limit Concentration
USC	United States Code
USCS	Unified Soil Classification System
UST	Underground Storage Tank
UXO	Unexploded Ordnance
VOA	Volatile Organic Analysis
VOC	Volatile Organic Compounds
WET	Waste Extraction Test
WMP	Waste Management Plan
WP	Work Plan
WPNSTA Concord	Naval Weapons Station Concord
WQEC	Weapons Quality Engineering Center

## EXECUTIVE SUMMARY

This report presents the results of, and recommendations based on, a remedial investigation (RI) conducted at five Inland Area sites at the Naval Weapons Station (NWS) Concord, California. The five sites include the following:

- Site 13 - Burn Area
- Site 17 - Building IA-24
- Site 22 - Building 7SH5
- Site 24A - Pistol Firing Range
- Site 27 - Building IA-20

The RI (1) characterized soil and groundwater contamination at each site; (2) identified potential contamination migration pathways and receptors associated with each site; (3) estimated the extent, nature, and rates of contaminant migration from each site; (4) completed a baseline human health risk assessment (HHRA) and a screening level qualitative ecological risk assessment (ERA); and (5) gathered data to support focused feasibility studies (FS).

During the RI, soil and groundwater were sampled from April 1995 to June 1995, and groundwater was sampled again in September 1995 to evaluate the environmental conditions and to assess the need for cleanup actions at the sites.

A screening-HHRA was conducted to evaluate the potential risks associated with environmental contamination at each of the Inland Area Sites. The objective of this assessment was to identify sites, environmental media, and chemicals of concern (COC) that pose health risks as well as those that pose little or no threat to human health. A COC is a chemical with a carcinogenic risk greater than  $1 \times 10^{-6}$  or a hazard quotient (HQ) greater than 1. To aid in the interpretation of the risk assessment results, magnitudes of the estimated carcinogenic risks and noncarcinogenic hazard indices (HI) were discussed relative to the following goals defined by the U. S. Environmental Protection Agency (EPA) and the California Environmental Protection Agency:

- A target risk range defined as an incremental lifetime carcinogenic risk to an individual of between  $1 \times 10^{-4}$  and  $1 \times 10^{-6}$

- A HI that does not exceed 1 for toxic effects other than cancer

In general, the Inland Area sites were classified as RI sites because previously collected data showed the presence of chemicals in soil or groundwater. As necessary, the information obtained in the RI will be used in the focused FS process to evaluate potential remedial technologies and alternatives. The results of the RI and the HHRA findings for each site, relative to the goals defined above, are summarized below by site and in Table ES-1. Recommendations are provided for each site.

### **SITE 13 - BURN AREA**

Portions of the Burn Area were used from the late 1940s through 1974 for the destruction of live ordnance and napalm. The ordnance destruction was conducted in gullies and trenches at the site.

**Soil.** The following metals were detected in soils collected at the Burn Area at concentrations exceeding their respective residential EPA Region IX preliminary remediation goals (PRG): aluminum, antimony, arsenic, barium, beryllium, cadmium, lead, manganese, and nickel. (PRGs are calculated from current EPA toxicity values with "standard" exposure factors to estimate concentrations in soil and groundwater that are protective of human health over a lifetime). Comparison of site concentrations to ambient levels of metals indicated that arsenic concentrations are indigenous to the site. (Ambient levels of metals are the concentrations that are naturally occurring in the soil and not the result of site activities.) The semivolatile organic compound (SVOC) benzo(a)pyrene was detected at concentrations greater than the PRG in two soil samples. No other COCs were detected in soil samples at concentrations greater than the PRG values. Total petroleum hydrocarbons quantified as diesel (TPH-D), and TPH quantified as motor oil (TPH-motor oil), were detected in soil samples at concentrations up to 23 and 1,700 milligrams per kilogram (mg/kg), respectively. PRGs do not exist for TPH concentrations because they represent a total concentration of many constituents and not a concentration for an individual chemical. Many of the petroleum hydrocarbon constituents were analyzed for as volatile organic compounds (VOC) or as SVOCs and compared to their respective PRGs. Samples collected from the drainage ditch at the base of the site indicate that TPH-motor oil is the only COC being transported off of the site by surface water flow. TPH-motor oil in soil will eventually biodegrade.

**Groundwater.** A single concentration of manganese detected in one groundwater sample exceeded its residential drinking water PRG. All other manganese concentrations detected in groundwater were below the tap water PRG. Manganese was also detected in an upgradient well and is indigenous in the

soil. During the second of two groundwater sampling rounds conducted at the site, TPH-D and one SVOC, 4-methylphenol, were detected at concentrations less than PRGs. No other organic compounds were detected in the groundwater, indicating that organic COCs detected in surface soils are not affecting groundwater beneath the site.

### **Human Health Risk Assessment**

The HHRA at Site 13 (the Burn Area) evaluated the potential carcinogenic risks and noncarcinogenic hazards associated with COCs in soil and groundwater under industrial worker and residential scenarios.

For the industrial worker, the reasonable maximum exposure (RME) to carcinogenic risks associated with COCs in surface and subsurface soil are below or within the target risk range and the hazard indices are less than the threshold value of 1. No industrial COCs were identified for Site 13.

For a resident, the total carcinogenic risk associated with simultaneous exposure to subsurface soil and groundwater is within the target risk range. The residential COCs in soil are beryllium and benzo(a)pyrene. Benzo(a)pyrene was detected at concentrations comparable to background levels in urban and rural soils. The total HI associated with residential exposure to COCs in soil and groundwater exceeds the threshold value of 1 and is attributed to the maximum concentration of manganese detected in groundwater. All other manganese concentrations detected in groundwater were below the drinking water PRG.

The RME lead concentrations in soil are below the California-modified residential PRG and the EPA Region IX industrial PRG. Lead concentrations in groundwater were below the residential drinking water PRG for lead. However, Site 13 soil analytical results from the RI showed lead present in two trench locations at concentrations (5,590 mg/kg and 3,090 mg/kg) above the industrial soil PRG. Based on these results, confirmation samples were collected in February 1996, to confirm the presence and assess the extent of the previously detected lead concentrations. The confirmation samples showed lead at concentrations significantly lower than those reported in the RI samples.

### **Ecological Assessment**

Several inorganic chemicals were detected above ambient levels in soils from the Burn Area. Those that were detected at above ambient levels and in greater than 10 percent of the soil samples included

beryllium, cadmium, lead, and zinc. Other than comparison to ambient concentrations, no screening guidelines for soil concentrations are available. Indirect measures of evaluating soil contamination included (1) comparison of waste extraction test (WET) extractions to chronic ambient water quality criteria (AWQC); (2) evaluation of toxicity using Microtox; and (3) evaluation of soil productivity based on pH and nutrient conditions. Results of these evaluations are summarized below.

Several chemicals detected in WET extractions from soil samples exceeded the chronic freshwater AWQC (copper, lead, mercury, and zinc). However, WET metal concentrations were generally two to three orders of magnitude less than metal concentrations in bulk soils, indicating that total metals measured in bulk soil are not bioavailable. Additionally, weak acid metal extractions completed as part of the comprehensive soil analysis indicated limited availability of both nutritive and potentially toxic metals, especially in surface soils where incidental ingestion of soil by terrestrial animals is most likely. Microtox bioassays indicated limited adverse effects at the site. Grassland habitat at the Burn Area is predominantly non-native and highly disturbed, confounding interpretations of contaminant-related stress. Based on soil measures of tilth and productivity, the site contains marginal grassland habitat that appears undifferentiated from the surrounding acreage.

A secondary assessment of risk posed by chemicals in soils at Site 13 focused on trophic transfer of contaminants from soil to plant and animal receptors. Results of the food-chain evaluation using conservative exposure parameters indicated potential risk to coyote and California quail from cadmium and lead, respectively, based on HQ. These HQs were calculated using maximum concentrations of chemicals in soil samples; actual exposures in the field is expected to be significantly less.

Based on these quantitative and qualitative screening evaluations, observations of the site during field surveys, and the land-use options being considered for the site (that is, no change in management practice), the Burn Area is recommended for no additional remedial action beyond that proposed based on human health risk assessment.

### **Recommendations**

Napalm residue and napalm related constituents that were detected in one burn trench during the site investigation (SI) are recommended for removal. After removal of the residue and napalm related contaminated soils is completed in October 1997, no additional action is recommended at the Burn Area.

## **SITE 17 - BUILDING IA-24**

Building IA-24 houses the forklift and forklift battery maintenance facility. Based on interviews with station personnel, a sump was used at the site for disposal of forklift battery acid waste; however, no evidence of a disposal sump was found during either the SI conducted in 1992 or this RI. A steam cleaner, used until 1988 to degrease forklifts and batteries, discharged steam condensate, oil, and grease through a pipeline to nearby Seal Creek. Two diesel underground storage tanks (UST) have also been used at the site. In addition, the site is served by a septic system and leachfield that may have received chemical wastes from the facility.

**Soil.** The results of soil sampling did not identify the location of the reported former acid waste disposal sump. The metals arsenic, beryllium, lead, nickel, and thallium were detected in soils samples at concentrations exceeding the respective residential PRGs. Comparison of site concentrations to ambient levels of metals indicates that arsenic and thallium concentrations are indigenous to the site. The SVOC benzo(a)pyrene was detected at concentrations greater than the residential PRG in two soil samples. No other COCs were detected in soil samples at concentrations greater than the residential PRGs. Sample results do not indicate that the use of USTs at the site have contaminated subsurface soils. TPH-motor oil was detected in all drainage surface samples, indicating that hydrocarbons are likely being transported off site. These long-chain petroleum hydrocarbons in soil will eventually biodegrade.

**Sediment.** Beryllium was detected in sediment at concentrations exceeding ambient levels for soils in the area. Although ambient soil concentrations are not directly comparable to sediment concentrations, they provide some indication of indigenous metal concentrations in the area. No sediment screening guideline for beryllium is available. In the single soil sample collected from the creek bank near the discharge pipe, several metals exceeded background concentrations; however, only nickel also exceeded the effects range median (ERM). (The ERM is the median, or 50<sup>th</sup> percentile, of the effects data compiled by Long and others [1995] on coastal marine and estuarine sediments in the United States.) TPH-motor oil was detected in sediments at concentrations up to 4,100 mg/kg, indicating that the steam cleaner outfall has contaminated the stream bed; however, these hydrocarbons will eventually biodegrade. No SVOCs or VOCs were detected in sediments.

**Groundwater.** The SVOC bis(2-ethylhexyl)phthalate was detected in two of the five groundwater samples collected during the first round of sampling at concentrations exceeding the residential drinking water PRG; however, this compound is a common laboratory contaminant that was detected in some

laboratory blank samples and may not indicate groundwater contamination. Bis(2-ethylhexyl)phthalate was not detected in the groundwater during the second round of groundwater sampling.

### **Human Health Risk Assessment**

The HHRA at Site 17 (Building IA - 24) evaluated the potential carcinogenic risks and noncarcinogenic hazards associated with exposure to COCs in soil, sediment, and groundwater.

For the industrial worker, the RME carcinogenic risks associated with COCs in surface soil and subsurface soil are within the target risk range and the total HIs are below the threshold value of 1. No industrial COCs were identified for Site 17.

For a resident, the total RME carcinogenic risk attributable to simultaneous exposures to COCs in soil and groundwater is within the target risk range and the total HI is less than the threshold value of 1. COCs identified for soil are beryllium and benzo(a)pyrene. Site concentrations of beryllium are comparable to ambient concentrations; no source for beryllium was identified. The risk associated with benzo(a)pyrene was based on the maximum concentration which is comparable to background levels in urban and rural soils. The risk associated with exposure to sediments alone is within the target risk range and the HI is below the threshold value of 1. The COCs identified for sediments are arsenic and beryllium and are present at concentrations below ambient levels in soil. The only groundwater COC identified is bis (2-ethylhexyl)phthalate. However, bis(2-ethylhexyl)phthalate was only detected during one groundwater sampling event.

The RME lead concentrations in surface soil and subsurface soil are significantly below the industrial PRGs. However, the RME lead concentration in surface soil, which is equal to the maximum lead concentration detected at the site, is slightly above the Cal-modified residential PRG. Only three of 46 samples contained lead at concentrations above this residential PRG and the mean lead concentration in surface soil was well below the residential PRG. The RME lead concentration in sediment is less than the residential PRG for soil. Lead was not detected in groundwater samples collected from monitoring wells at Site 17.



## **Ecological Assessment**

Risk to aquatic biota at Seal Creek was evaluated by comparing site-specific sediment data to (1) site-specific soil ambient concentrations, and (2) effects ranges published by the National Oceanic and Atmospheric Administration (NOAA). Beryllium in sediment samples exceeded background concentrations for soils in the area. In the single soil sample collected from the creek bank near the discharge pipe, several metals exceeded background concentrations; however, only nickel also exceeded the ERM.

Sediment extraction data was compared to chronic freshwater AWQC. Zinc exceeded the AWQC in one WET extraction sample. This portion of Seal Creek is deeply scoured during winter storms; sediment sampled during this RI is not necessarily representative of past or future condition due to sediment dynamics. No ecological risk analysis for Site 17 was conducted. However, because Seal Creek is a functional riparian zone potentially affected by activities on the base, its long term management should be addressed under the NWS Concord Natural Resource Management Plan.

## **Recommendations**

No removal action or remediation are recommended for this site. Groundwater should be monitored for two additional quarters (a total of four quarters) and the necessity of remedial action assessed. Surface water samples will not be collected at Seal Creek during the winter because no organic or inorganic constituents that have been assigned PRGs were consistently detected in the soil and sediment samples.

## **SITE 22 - BUILDING 7SH5**

Building 7SH5 was a missile wing and fin repair facility. Paints, oils, and solvents used at the facility were reportedly disposed of in an earthen pit or drainage ditch at the site. No evidence of a disposal pit was found during the 1992 SI or this RI. A diesel UST and product piping have also been in use at the site. In addition, the site is served by a septic system and leachfield that may have received chemical wastes from the facility.

**Soil.** The metals arsenic, beryllium, and lead were detected in soil samples collected at concentrations exceeding the respective residential PRGs. No other chemicals were detected in soil samples at concentrations greater than the PRG values. TPH-D and TPH-motor oil detected in site soils are

associated with the use of the diesel UST and product piping. Samples collected from the drainage ditch at the base of the site indicate that TPH-motor oil compounds are likely being transported off site. These petroleum hydrocarbons will eventually biodegrade.

**Groundwater.** One VOC, trichloroethene (TCE) was detected in one grab groundwater sample at a concentration greater than its residential drinking water PRG. No SVOCs were detected in the groundwater samples. TPH-motor oil was detected in all groundwater samples collected at the site and are likely associated with the use of the diesel UST and product piping.

### **Human Health Risk Assessment**

The HHRA conducted at Site 22 (Building 7SH5) evaluated the potential carcinogenic risks and noncarcinogenic hazards associated with exposure to COCs in soil and groundwater under industrial and residential scenarios.

For the industrial worker, the RME carcinogenic risks associated with COCs in surface and subsurface soil are within the target risk range and the total HIs for both soil depth intervals are below the threshold value of 1. Arsenic is the only industrial COC identified at the site.

For a resident, the total carcinogenic risk associated with simultaneous exposure to COCs in subsurface soil and groundwater is at the upper limit of the target risk range. The HI, which is greater than the threshold value of 1, is attributable to arsenic in soil. Arsenic is the only residential COC identified in soil. For groundwater, the risk is attributed to a single detection of TCE.

The RME lead concentrations in surface soil and subsurface soil are significantly below the industrial PRGs of 1,000 mg/kg. However, the RME lead concentration in surface soil is slightly above the Cal-modified residential PRG. Only one sample of lead contained a lead concentration above the residential PRG.

### **Ecological Assessment**

No ERA was warranted at this site for the following reasons:

- Lack of viable habitat at or adjacent to this site

- Limited site use by receptors
- Low chemical concentrations

### **Recommendations**

No further action is recommended for the site. Three monitoring wells have been installed to characterize the nature and extent of TCE in the groundwater beneath the site. Groundwater should be monitored for at least four quarters and the necessity of remedial action assessed.

### **SITE 24A - PISTOL FIRING RANGE**

The Pistol Firing Range has been in use since at least the mid-1960s. The lead-centered, copper-jacketed bullets lodged in a berm behind the target area. Potential leaching of metals from the target berm into surface water necessitated the RI at this site.

**Soil.** The metals antimony, arsenic, beryllium, cadmium, and lead were detected in soil samples collected at the Pistol Firing Range at concentrations exceeding their respective residential PRGs. Eight SVOCs were detected at concentrations greater than the PRG in two soil samples, probably the result of creosote-preserved timbers used at the site. Samples collected from the site drainage ditch at the base of the site indicate that metals may be being transported off site.

### **Human Health Risk Assessment**

The HHRA conducted at Site 24A (the Pistol Firing Range) evaluated the potential carcinogenic risks and noncarcinogenic hazards associated with exposure to COCs in soil under industrial and residential scenarios.

For the industrial worker, the RME carcinogenic risks associated with COCs in surface and subsurface soil are within the target risk range and the HI for both soil depth intervals are below the threshold value of 1. For both depth intervals, risks can be attributed to ambient levels of arsenic. For subsurface soil, polynuclear aromatic hydrocarbons (PAHs) (including benzo(a)pyrene) were also identified as COCs. The risks associated with PAHs at the site were based on the maximum concentrations of these chemicals.

For a resident, the RME carcinogenic risk associated with exposure to COCs in surface soil is within the target risk range, and the risk for subsurface soil exposure slightly exceeds the target risk range. For both depth intervals, the risks can be attributed to ambient levels of arsenic and beryllium. The RME site concentrations of these COCs are below the ambient levels established for Site 24 A. For subsurface soil, the risks are also attributable to the maximum concentrations of PAHs detected at the site. The III for both soil depth intervals are slightly greater than the threshold value of 1. However, no chemical-specific HQ exceeded 1.

Five samples in the vicinity of the firing berm and adjacent drainage ditch contained lead concentrations greater than the EPA Region IX industrial soil PRG and eight samples in this area exceed the Cal-modified residential PRG. However, lead concentrations diminish significantly with distance from the target berm.

### **Ecological Assessment**

No ecological risk assessment was completed at this site, based on the following:

- Low habitat value of the site
- Rapid attenuation of lead near the site
- Active status of firing range

### **Recommendations**

Lead and PAHs detected in the surface soil may be transported off site via surface water from storm water erosion. Engineering controls, such as installation of sediment traps or other modifications to the site drainage, are recommended for Site 24A to minimize the off-site transport of contaminants.

### **SITE 27 - BUILDING IA-20**

Building IA-20 houses a chemical and materials testing laboratory. An area behind the building was reportedly used for disposal of wastes generated at the site. A diesel UST was used at the site but has been removed.

**Soil.** The pesticides alpha-Chlordane, gamma-Chlordane, and 4,4-DDD; polychlorinated biphenyls (PCB) Aroclor 1248 and Aroclor 1254; and the herbicide dieldrin were detected in soil samples collected at Site 27 at concentrations exceeding their respective residential PRGs. VOCs and SVOCs detected in soil samples were below the residential PRG values. TPH constituents were detected at the site and are associated with the use of a diesel UST and possibly weed suppressant around the building perimeters. Samples collected from the drainage ditch at the base of the site indicate that TPH constituents and PCBs are being transported off site.

### **Human Health Risk Assessment**

The HHRA conducted at Site 27 (Building IA-20) evaluated the potential carcinogenic risks and noncarcinogenic hazards associated with exposure to COCs in soil.

For the industrial worker, the RME carcinogenic risks associated with COCs in surface soil and subsurface soil are within the target risk range and the HIs are equal to the threshold value of 1. Alpha-chlordane and gamma-chlordane are the only industrial COCs identified for Site 27.

For a resident, the RME carcinogenic risks for surface soil and subsurface soil are at the upper limit of the target risk range. The residential COCs for Site 27 include alpha-chlordane, gamma-chlordane, Aroclor-1248, Aroclor-1254, dieldrin and 4,4-DDD (surface soil only). For surface soil, the risks associated with alpha-chlordane and gamma-chlordane were based on the maximum concentrations detected at the site. However, the risks associated with the average concentrations of these chemicals are well within the target risk range. The HIs for both soil depth intervals are greater than the threshold value of 1 and can also be attributed to chlordane concentrations detected around the building foundations.

### **Ecological Assessment**

No ERA was conducted at this site based on the following:

- Low levels of chemicals detected at the site
- Lack of available habitat at or adjacent to the site

**Recommendation**

The site does not pose significant environmental risk. No removal action or remediation is recommended for Site 27.

TABLE ES-1

**SUMMARY OF PRELIMINARY RECOMMENDATIONS AND CONCLUSIONS  
FOR THE REMEDIAL INVESTIGATION AND QUALITATIVE ECOLOGICAL ASSESSMENT**

Site	Human Health Risk Assessment			Qualitative Ecological Risk Assessment Conclusions	Preliminary Recommendations
	Human Health Risk Result (RME) <sup>a</sup>	Human Health Chemicals of Concern (COC) <sup>b</sup>	Conclusion		
Site 13 Burn Area Site	Residential Risk: $7 \times 10^{-6}$ HI = 4	Soil: Beryllium, benzo(a)pyrene levels comparable to rural and urban soils. <b>Groundwater:</b> Manganese	Human Health Risk within the EPA's target risk range. HI is attributable to manganese in groundwater.	The site does not pose an immediate risk to ecological receptors.	A removal of the napalm is scheduled for September 1997. Upon completion of the napalm removal activities, no further action for soil and groundwater is recommended for this site.
	Industrial Risk: $7 \times 10^{-7}$ HI < 1	No industrial COCs were identified.	Human Health Risk below the EPA's target risk range. HI is less than the threshold value.		
Site 17 Building IA-24	Residential Risk: $2 \times 10^{-5}$ HI < 1	Soil: Beryllium and benzo(a)pyrene levels comparable to rural and urban soils. <b>Groundwater:</b> Bis(2-ethylhexyl)phthalate	Human Health Risk within the EPA's target risk range. HI is less than the threshold value.	The site does not pose an immediate risk to ecological receptors.	No further action is recommended for this site.

TABLE ES-1 (Continued)

**SUMMARY OF PRELIMINARY RECOMMENDATIONS AND CONCLUSIONS  
FOR THE REMEDIAL INVESTIGATION AND QUALITATIVE ECOLOGICAL ASSESSMENT**

Site	Human Health Risk Assessment			Qualitative Ecological Risk Assessment Conclusions	Preliminary Recommendations
	Human Health Risk Result (RME)*	Human Health Chemicals of Concern (COC) <sup>b</sup>	Conclusion		
Site 17 Building IA-24 (Continued)	Residential Risk: (for sediment only) $2 \times 10^{-5}$ HI < 1	Sediment: Arsenic and beryllium present at ambient levels	Human Health Risk within the EPA's target risk range. HI is less than the threshold value.		
	Industrial Risk: $1 \times 10^{-6}$ HI < 1	Soil: No industrial COCs were identified.	Human Health Risk at lower limit of the EPA's target risk range. HI is less than the threshold value.		
Site 22 Building 7SH5	Residential Risk: $1 \times 10^{-4}$ HI = 3	Soil: Arsenic Groundwater: Trichloroethene	Human Health Risk at the upper limit of the EPA's target risk range. HI is attributable to arsenic in soil	An ERA was not performed for this site	Four quarters of monitoring are in progress to evaluate groundwater. At this time, no further action is recommended for this site.
	Industrial Risk: $4 \times 10^{-5}$ HI < 1	Soil: Arsenic	Human Health Risk within the EPA's target risk range. HI is less than the threshold value.		



TABLE ES-1 (Continued)

**SUMMARY OF PRELIMINARY RECOMMENDATIONS AND CONCLUSIONS  
FOR THE REMEDIAL INVESTIGATION AND QUALITATIVE ECOLOGICAL ASSESSMENT**

Site	Human Health Risk Assessment			Qualitative Ecological Risk Assessment Conclusions	Preliminary Recommendations
	Human Health Risk Result (RME)*	Human Health Chemicals of Concern (COC) <sup>b</sup>	Conclusion		
Site 24A Pistol Firing Range	Residential Risk: $3 \times 10^{-4}$ HI = 2	Soil: Arsenic and beryllium present at ambient levels, PAHs, and lead	Human Health Risk exceeds the EPA's target risk range. HI exceeds the threshold value.	An ERA was not performed for this site	This site is still active and is no longer part of the IRP. Engineering controls are recommended for this site and should be implemented by the NWS.
	Industrial Risk: $3 \times 10^{-6}$ HI < 1	Soil: Arsenic present at ambient levels and lead	Human Health Risk is within the EPA's target risk range. HI less than the threshold value.		
Site 27 Building	Residential Risk: $1 \times 10^{-4}$ HI = 10	Soil: alpha-Chlordane, gamma-Chlordane, Aroclor-1248, Aroclor-1254, and dieldrin	Human Health Risk at the upper limit of the EPA's target risk range. HI exceeds the threshold value.	An ERA was not performed for this site	No further action for soil is recommended for this site.
	Industrial Risk: $4 \times 10^{-5}$ HI = 1	Soil: alpha-Chlordane and gamma-Chlordane	Human Health Risk within the EPA's target risk range. HI is equal to the threshold value.		

**TABLE ES-1 (Continued)**

**SUMMARY OF PRELIMINARY RECOMMENDATIONS AND CONCLUSIONS  
FOR THE REMEDIAL INVESTIGATION AND QUALITATIVE ECOLOGICAL ASSESSMENT**

**Notes:**

- |            |  |
|------------|--|
| <b>a</b>   | For Sites 13, 17, and 22, the residential risk is the total risk associated with simultaneous exposure to COPCs in subsurface soil (0 to 10 foot bgs) and groundwater, and the HI is also the total hazard index. For Site 17, the risk and hazard for COPCs in sediment are evaluated separately. For Sites 24A and 27, where groundwater was not evaluated, the residential risks are for COPCs in subsurface soil (0 to 10 foot bgs) only. The industrial risks for all sites are the carcinogenic risks and hazard indices associated with industrial exposure to COPCs in surface soil (0 to 2 foot bgs). |
| <b>b</b>   | The chemicals of concern (COC) are identified for the RME case only. The chemicals (or chemical classes) listed are those for which the chemical-specific risk exceeds IE-06 or the hazard quotient exceeds 1.   |
| <b>EPA</b> | U.S. Environmental Protection Agency   |
| <b>HI</b>  | Hazard index   |
| <b>PRG</b> | EPA Region IX preliminary remediation goals  |
| <b>RME</b> | Reasonable maximum exposure  |

## 1.0 INTRODUCTION

The Department of the Navy, Engineering Field Activity West (EFA WEST) is conducting a remedial investigation/feasibility study (RI/FS) at the Inland Area of the Naval Weapons Station (NWS) Concord, California (Figure 1-1). EFA WEST has authorized Tetra Tech Environmental Management, Inc. (TtEMI), formerly known as PRC Environmental Management, Inc. (PRC) and team member, Montgomery Watson, formerly James M. Montgomery, Inc. (JMM) to develop this RI report under the Comprehensive Long-term Environmental Action Navy (CLEAN) Contract No. N62474-88-D-5086, Contract Task Order (CTO) 0303.

This RI report describes field investigation activities, interprets the geology and hydrogeology, identifies applicable regulations governing this investigation, presents the nature and extent of chemicals in soil and groundwater, estimates the human health risk and ecological risk (Sites 13 and 17 only), describes the movement and reaction of chemical contaminants in the environment, and provides recommendations at the following five Inland Area sites:

- Site 13 - Burn Area
- Site 17 - Building IA-24
- Site 22 - Building 7SH5
- Site 24A - Pistol Firing Range
- Site 27 - Building IA-20

A 1992 site investigation (SI) of one Tidal Area site and 10 Inland Area sites recommended further investigation at these five Inland Area sites (PRC/Montgomery Watson 1993a). Project plans were developed to conduct further sampling and investigation to determine possible contamination at these sites (Figure 1-2) and were implemented during field activities (PRC/Montgomery Watson 1995a,b,c,d).

The following introductory sections describe the purpose of this RI report, the history and background of NWS Concord, the RI project plans, the approach to presenting the RI analytical results, and the report organization.

## **1.1 PURPOSE OF THE REPORT**

The broad goal of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedy selection process is to determine whether a site poses a risk to human health and the environment, and, if so, to select a remedy that will eliminate, reduce, or control those risks. One of the main steps in this process is the RI/FS. The RI characterizes the environmental conditions at the site. The FS develops and evaluates remedial alternatives based on the data collected in the RI. This report presents the results of the RI. The following sections further describe the RI/FS process at NWS Concord and the purpose of this report.

### **1.1.1 The Installation Restoration Program**

CERCLA and the Superfund Amendments and Reauthorization Act of 1986 (SARA) established a series of programs for the cleanup of hazardous materials disposal sites and release sites nationwide. One of this series, the Defense Environmental Restoration Program (DERP), is codified in SARA Section 211 (10 United States Code [USC] 2701). The Navy Installation Restoration Program (IRP) is a component of DERP, and is designed to identify, assess, and remediate contamination at past hazardous materials disposal sites and release sites that resulted from Navy and Marine Corps activities.

A site qualifies for funds under the IRP depending on when the disposal operations occurred and on the type of waste disposed. The IRP is intended to address the cleanup of contamination resulting from past, but not current, disposal operations. The IRP is primarily intended to clean up these past waste disposal or spill areas that endanger public health (welfare) or the environment and may include such chemicals as polychlorinated biphenyls (PCB); metals; petroleum, oil, and lubricants (POL); pesticides; paints and solvents; and ordnance products. Sites not covered by the IRP are addressed under other Navy programs.

The Navy's IRP follows a process developed by the U.S. Environmental Protection Agency (EPA) pursuant to CERCLA to identify, assess, and remediate hazardous waste sites (EPA 1988). The CERCLA process consists of three main activities:

- Preliminary Assessment (PA) and Site Inspection (SI)
- Remedial Investigation and Feasibility Study

- **Remedial Design and Remedial Action**

The first step under CERCLA, the PA/SI, serves several purposes, such as to eliminate from further consideration these sites that do not pose a risk to human health and the environment, to determine the need for a removal action, and to score the site using the Hazard Ranking System (HRS). The PA relies on existing information about the site, whereas the SI involves collection of data to characterize the site further.

The second step consists of the RI, and, if the site is found to pose a risk to human health or the environment, the FS. The RI involves a more detailed evaluation of the site to identify the nature and extent of chemicals present, and may include multiple field efforts to collect sufficient data in the most cost-efficient manner possible. The FS uses the information developed in the RI to evaluate alternatives for correcting problems at the sites. The lead agency then identifies the alternative that best meets the requirements of CERCLA and presents that alternative to the public in a proposed plan. Based on comments received from the public, a final alternative is selected and is documented in the Record of Decision (ROD).

The third step includes the remedial design and remedial action. The remedial design involves the preparation of design specifications and drawings to implement the selected alternative. The remedial action refers to actual implementation of the remedy through construction.

#### **1.1.2 Federal Facility Agreement**

A Federal Facility Site Remediation Agreement (FFSRA) between the Navy and state regulatory agencies was signed on September 29, 1992. The FFSRA for NWS Concord defines the activities and responsible parties involved in the IRP process at the various sites. These activities are conducted in cooperation and close coordination with the State of California Department of Toxic Substances Control (DTSC), EPA Region IX, the San Francisco Bay Regional Water Quality Control Board (RWQCB), the U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration (NOAA), the California Department of Fish and Game, the Contra Costa County Public Health Department, and other appropriate regulatory agencies.

On December 16, 1994, NWS Concord was included on the federal National Priorities List (NPL) primarily due to potential migration of contaminants at sites in the Litigation Area. DTSC originally was the lead agency for the Inland Area investigation at NWS Concord under the FFSRA; however, EPA became the lead regulatory agency once NWS Concord became an NPL site. A Federal Facilities Agreement (FFA) will be developed and signed by the Navy and EPA; until then, the current FFSRA will be followed.

### **1.1.3 Remedial Investigation Objectives**

The specific objectives of the RI for the five sites at NWS Concord are as follows:

- Characterize the vertical and lateral extent of soil contamination at each site for the purpose of developing and evaluating effective remedial alternatives.
- Characterize groundwater contamination at Sites 13, 17, and 22 for the purpose of developing and evaluating remedial alternatives.
- Identify potential contamination migration pathways and associated receptors for each site, and determine the extent, nature, and rates of contaminant migration from each site.
- Gather data for a baseline human health risk assessment at all sites and for the ecological risk assessment at Sites 13 and 17.
- Gather data to support initial FS activities, such as technology screening and treatability studies, conducted concurrently with the RI.

This RI report was prepared with these objectives in mind, in accordance with the revised National Contingency Plan (NCP) and EPA's Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA Interim Final (EPA 1988). The data gathered during the RI are used to evaluate whether the site poses a risk to human health or the environment. If a risk exists, the RI data will be used in the FS process to evaluate remedial alternatives.

## **1.2 FACILITY BACKGROUND**

The following sections describe the location, history, current operations, and previous environmental assessments of NWS Concord.

### **1.2.1 Location**

NWS Concord is the major naval munitions transshipment facility on the West Coast and is located in the north-central portion of Contra Costa County, California, approximately 30 miles northeast of San Francisco. The facility, which encompasses approximately 13,000 acres, is bounded by Suisun Bay to the north, by Los Medanos Hills and the city of Pittsburg to the east, and by the city of Concord to the south and west. Currently, the facility contains three main separate land holdings, the Tidal Area (which includes islands in Suisun Bay), the Inland Area, and a radiography facility in Pittsburg, California (Figure 1-1).

The Inland Area, separated from the Tidal Area by Los Medanos Hills which are not owned by the Navy, encompasses approximately 6,200 acres. A Navy-owned road and rail line link the two areas. The Inland Area lies between Los Medanos Hills and the city of Concord, and is crossed by three public roads: State Route 4, Willow Pass Road, and Bailey Road (Figure 1-3). Additionally, the northwest section of the base is crossed by the Contra Costa Canal, which supplies drinking water to the cities of Clyde, Concord, Pleasant Hill, and parts of Martinez and Walnut Creek.

### **1.2.2 History**

In December 1942, the Navy commissioned the ordnance shipping depot at Naval Magazine, Port Chicago, now known as the Tidal Area of NWS Concord. When munitions passing through the Port Chicago waterfront exceeded the capacity of the new facility, a 5,143-acre area of land in the Diablo Creek Valley was acquired. This land became the Inland Area of NWS Concord (Ecology & Environment, Inc. [E&E] 1983).

On July 7, 1944, an explosion occurred aboard a Liberty Ship (the E.A. Bryan) docked at Port Chicago. Approximately 3.5 million pounds of explosives were detonated; the cause is unknown. The explosion killed 322 people, injured 390 others, and caused approximately \$12.5 million in property damage. Continuing operations at the station were necessary for the war effort, so reconstruction began without delay (E&E 1983).

Ordnance transportation from Port Chicago continued at a high volume, but began to decrease in May 1945, when Germany surrendered. Operations continued to slow when Japan surrendered in August of the same year. Activities at the port did not increase again until 1953 when they peaked during the Korean War. Similarly, activities peaked from 1969 to 1972 during the Vietnam War (E&E 1983), and in 1991 during the Gulf War.

Over the years, the weapons increased in sophistication and the Naval Magazine, Port Chicago, responded by adding specialized facilities such as quality evaluation and engineering laboratories, industrial X-ray units, guided missile test and repair center, laboratories, and special weapons service and storage. These additions to Port Chicago expanded the activities from ordnance transportation and shipment to comprehensive ordnance support. This expansion resulted in the consolidation of the Naval Magazine, Port Chicago and the Naval Ammunition Depot, Mare Island into NWS Concord in December 1957. The Mare Island Depot was an annex of the station until June 1972 when it was turned over to the Naval Ship Yard, Mare Island. The Naval Ship Yard, Mare Island, closed in 1996.

NWS Concord is a third echelon command under the authority of the Commander, Naval Seas Systems Command (NAVSEA). NWS Concord is one of five NAVSEA weapons stations, serving a dual purpose within NAVSEA. The station functions as the primary port of embarkation for ordnance materials on the West Coast and is homeport for the ammunition ships (auxiliary explosives [AE]) of Service Squadron Three (SERVON 3). The station is also maintained by NAVSEA to provide fleet combatants with ready-for-use ordnance. This station provides 16 tenant activities with varying administrative and logistic support.

### **1.2.3 Current Operations**

Industrial operations at NWS Concord have been associated primarily with routine ammunition transshipment and ordnance facility activities. In this area, both containerized and break-bulk munitions are received, inspected, and classified; held awaiting transportation; and outloaded. Industrial operations at the Inland Area of NWS Concord have been associated primarily with munitions storage, support, supply, public works, and administrative facilities. The Inland Area maintains five magazine groups for ammunition storage. The Inland Area also houses several production and maintenance facilities for weapons. The northwest corner of the Inland Area is used for support operations such as an



administrative complex, public works department, personnel housing, and a 162-acre golf course (of which 80 acres are owned by the city of Concord). A Weapons Quality Engineering Center (WQEC) is located between State Route 4 and Willow Pass Road. An abandoned airfield south of State Route 4 is used for forklift operator training, and approximately 1,000 acres of NWS Concord land are leased for cattle grazing.

#### **1.2.4 Other Environmental Assessments**

**Initial Assessment Study (IAS)** - The IAS, similar to a preliminary assessment, of NWS Concord facilities was conducted under a precursor to the current IRP called the Navy Assessment and Control of Installation Pollutants (NACIP). Results of the initial phase of investigation are published as the "Initial Assessment Study of Naval Weapons Station, Concord, California" (E&E 1983). This initial study consisted of record searches, NWS employee interviews, and ground and aerial tours of the station. Information from these sources was used to rank the sites and determine if the sites posed a potential danger to human health or to the environment. The IAS included 26 sites at NWS Concord, of which 12 were designated as Inland Area sites. The Inland Area sites included in the IAS are as follows:

- Site 13 - Burn Area
- Site 14 - Kinne Boulevard Wells
- Site 15 - Railroad Classification Yard
- Site 16 - Black Pit at Red Rock
- Site 17 - Building IA-24
- Site 18 - Building IA-25
- Site 19 - Seal Creek
- Site 20 - Old Homestead, Seal Creek
- Site 21 - Building 97 Fuel Tanks
- Site 22 - Building 7SH5
- Sites 23A and 23B - Inland Area Explosive Ordnance Disposal
- Sites 24A and 24B - Pistol Firing Range and Aircraft Firing Range

Of these 12 sites, the IAS identified three sites (Sites 13, 14, and 16) as areas of potential contamination and recommended them for further study. These three sites were further investigated as part of the confirmation study (Anderson Geotechnical Consultants [AG] and Brown and Caldwell Consulting Engineers [B&C 1984]) and Site 14 was further investigated in the Kinne Boulevard Wells Sampling (B&C 1986).

Additional Inland Area sites were further investigated in two different studies. Site 18 was further studied in an SI at Building IA-25 (International Technology Corporation [IT Corp.] 1990), and the investigation and removal action at Site 21 was reported in the "Removal and Closure of 16 Underground Fuel Tanks at the Naval Weapons Station Concord" (IT Corp. 1991).

**Confirmation Study** - The confirmation study investigated the three NWS Concord Inland Area sites identified in the IAS. At the Site 13 Burn Area, shallow soil samples (less than 1.5 feet below ground surface [bgs]) were collected and analyzed for arsenic, barium, copper, lead, and extractable organics (one sample). The soil samples contained metals at concentrations well below the California total threshold limit concentration (TTL) limits for hazardous waste, and the site was not recommended for further action. However, the Navy felt it prudent to conduct further investigations at Site 13, which would focus the investigation on the areas that were used for burning munitions.

The Site 14 wells (Kinne Boulevard Wells) were not sampled during the confirmation study because the wells had been plugged with concrete riprap. In the confirmation study, the wells were proposed for cleanout and sampling during a separate investigation (B&C 1986).

At Site 16, the Black Pit at Red Rock, soil samples were collected and analyzed for arsenic, barium, copper, lead, vanadium, and organics (purgeable and extractable). Soils contained metals at concentrations much lower than the TTLs, and organic constituents were less than the analytical detection limit. Under CTO 303, six additional soil samples were collected in February 1996 at depths of 0.5 and 2.0 feet bgs and analyzed for metals. Based on these results, no further investigation is planned at Site 16.

**Site Investigation** - During negotiations between the Navy and regulatory agencies in 1987, Site 16 was removed from the IAS list of Inland Area sites and a new site, Site 27 (Building IA-20), was added.

Sites 23 and 24 contained two areas of investigation that were located in different portions of the station. Therefore, future investigations split these two sites into four sites, for a total of 14 Inland Area sites. Of those 14 sites, the Navy identified eight sites (Sites 17, 19, 22, 23A, 23B, 24A, 24B, and 27) for further investigation in a proposed Inland Area RI/FS (later changed to an SI). In addition to these eight sites, Sites 13 and 14 and a Tidal Area site (Site 8 - Ryer Island) were added to make a group of 11 total sites to be investigated under the SI.

A draft final work plan, draft final sampling plan, and final quality assurance project plan for the Inland Area Sites were prepared by IT Corp. under the Hazardous Waste Remedial Action Program (HAZWRAP) and submitted to the Navy and regulatory agencies in July 1989 (IT Corp. 1989). During the preparation of these work plans, IT Corp. used various sources of information, including site visits and reconnaissance, aerial photos, previous investigation reports, water well logs, geological reports, and facility operation background data. Although written under the title of an RI, EFA WEST, DTSC, and RWQCB agreed that the overall objective and intent of the work plans for the Phase I investigation at the 11 Inland Area sites was oriented more toward an SI than a true RI. Subsequently under CLEAN, the work performed by IT Corp. was incorporated into the TtEMI/JMM SI Work Plan (WP), Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPjP), and Health and Safety Plan (HSP) (PRC/JMM 1992a,b,c,d) for the SI activities at the Inland Area sites of NWS Concord. TtEMI/JMM project plans were approved by DTSC and RWQCB in March 1992.

The overall objective of the SI was to gather information for assessing the presence or absence of contamination within the Inland Area of NWS Concord. The 11 sites included in the SI were:

- Site 8 - Ryer Island
- Site 13 - Burn Area
- Site 14 - Kinne Boulevard Wells
- Site 17 - Building IA-24
- Site 19 - Seal Creek
- Site 22 - Building 7SH5 - Missile Wing and Fin Repair Facility
- Site 23A - Inland Area Explosive Ordnance Disposal

- Site 23B - Eagle's Nest Explosive Ordnance Disposal
- Site 24A - Pistol Firing Range
- Site 24B - Aircraft Firing Range
- Site 27 - Building IA-20 - Weapons Quality Engineering Center Chemical Laboratory

The objectives for the field activities at these sites, which were conducted between June 15, 1992 and August 28, 1992, were as follows:

- Identify those sites that do not pose an existing or potential threat to public health or the environment.
- Identify concentrations of contaminants in soil and water relative to regulatory standards.
- Determine the appropriateness of removal actions.
- Collect data to characterize the sites and, if appropriate, initiate an RI.
- Recommend further action, if required, at any of the SI sites.

No ambient samples were collected during the SI. To assist in identifying samples that apparently reflect elevated concentrations of inorganic constituents, and therefore sites that may require additional investigation, two measures of the upper limits on the range of observed values were calculated for the SI. The SI assumed metal concentrations above the arithmetic mean plus three standard deviations (AM/3SD) level indicated metal contamination at the site. Metal concentrations below the 95%/95% tolerance interval (95/95 TI) preliminarily suggested that elevated levels due to site activities were not evident.

Based on the SI data, Sites 8, 23A, 23B, and 24B were recommended for no further action because no evidence of contamination was detected. Sites 13 (napalm only), 14, and 19 were proposed for immediate action/removal. Napalm that was identified at Site 13 was recommended for cleanup. The Kinne Boulevard Wells at Site 14 were proposed for proper abandonment. The two 55-gallon drums found in Seal Creek (Site 19) were recommended for removal action, and the refuse within the creek was recommended for removal. Sites 13, 17, 22, 24A, and 27 were recommended for further investigation

under an RI. During the SI, underground storage tanks (UST) were found at Sites 17, 22, and 27. These USTs were investigated during the RI in conjunction with the continued investigations at the sites.

The wells at Site 14 were properly abandoned in April 1995 in accordance with the closure work plan (PRC 1994). The contents of the two drums in Seal Creek (Site 19) were analyzed in 1992 and confirmed to be nonhazardous; the drums were subsequently removed. No further response action planned (NFRAP) designations for Sites 8, 14, 19, 23A, 23B, and 24B are currently being proposed by the Navy, who is awaiting the regulatory agencies concurrence.

**Solid Waste Management Unit (SWMU) Investigation** - The SWMU investigation was conducted at NWS Concord in 1995. The results of this investigation are presented in the draft Resource Conservation and Recovery Act (RCRA) Facility Assessment Confirmation Study Report (PRC 1996e). Three of the SWMU sites are adjacent to the RI sites. SWMU Sites 12/20 are located on the west and east sides of Site 17, and SWMU Site 52 is located on the north end of Site 22. The data collected from these three SWMU sites are discussed in this RI report because of the close proximity of the SWMU sites to the RI sites.

#### **1.2.5 Stormwater Management**

This section describes the status of the storm water management program at NWS Concord. Naval activities are directed to comply with requirements of the Clean Water Act (CWA) of 1997 and the regulations issued under the act. The CWA was amended in 1987 with an emphasis on controlling storm water discharges. The amendments specify National Pollutant Discharge Elimination System (NPDES) requirements for storm water discharges. The amendments also require industrial facilities to obtain NPDES permits to cover their storm water discharges associated with industrial activities. California has been granted NPDES permitting authority by the EPA and has implemented a permitting program through the California State Water Resources Control Board (CSWRCB) and its nine RWQCB regions. Each RWQCB region may also impose more stringent requirements. The CSWRCB requires industrial facilities to comply with the CSWRCB General Permit requirements or obtain an individual permit. An industrial facility that intends to comply with the CSWRCB General Permit requirements or individual permit requirements is subject to the authority of the RWQCB, which has jurisdiction in the area where the facility is located. In California, the Navy has chosen to comply with the CSWRCB General Permit

requirements rather than apply for individual permits for each Naval facility and must therefore comply with requirements as implemented and enforced by the RWQCB, San Francisco Bay Region.

NWS Concord discharges storm water from a land area that is associated with industrial activities and is covered by an NPDES permit. It has submitted a Notice of Intent (NOI) to comply with the CSWRCB General Permit requirements, order number 91-13-DWQ. The three main objectives of the NPDES permit program are to (1) identify and correct the sources of potential pollution that may affect the quality of storm water discharges; (2) identify and monitor the sources of potential pollution that may affect the quality of storm water discharges; and (3) identify and implement best management practices (BMP) to reduce potential pollution of storm water discharges.

The CSWRCB General Permit requires development and implementation of a Stormwater Pollution Prevention (SWPP) Plan. The purpose of implementing an SWPP Plan is to reduce or eliminate pollutants discharged to waters of the United States. NWS Concord has developed a SWPP Plan (PRC and Montgomery Watson 1993b) that applies to storm water discharges from industrial areas at NWS Concord. Industrial activities at NWS Concord include vehicle maintenance; hazardous waste treatment, storage, or disposal (RCRA Subtitle C); material storage; vehicle storage; material handling; power generation (for back-up purposes only); recycling; and ordnance repair. NWS Concord also stores, treats, or handles the following materials: solvents, pesticides (for pest control and vegetation removal), scrap metal, petroleum products, hazardous wastes, paints, and ordnance.

NWS Concord discharges storm water in three ways: directly to storm drain systems, directly to U.S. waters, or indirectly to U.S. waters. Seal Creek is the closest receiving body of water in the Inland Area, and Suisun Bay is the closest receiving body of water in the Tidal Area.

### **1.3 REMEDIAL INVESTIGATION PROJECT PLANS**

The SI report proposed recommendations for future work at the NWS Concord Inland Area sites. These recommendations were the basis for designing the RI at the five Inland Area sites, which are shown on Figure 1-3. The project plans present the RI currently being conducted at the NWS Concord Inland Area, and are briefly described below (PRC/Montgomery Watson 1995a,b,c,d, and PRC 1995b):

- **Work Plan:** The WP describes the proposed implementation of the RI activities from the planning stage to completion of the FS. The WP is the most comprehensive of the project plans, and describes the RI/FS process and site history, settings, and RI objectives. The WP presents the rationale and methodology for conducting the RI, based on a review of the information available for each of the sites. Volume II is the ecological assessment (EA) work plan.
- **Field Sampling Plan:** The FSP, together with the QAPjP, comprises the Sampling and Analysis Plan, and provides guidance for all field work by defining the sampling and data-gathering methods and rationale to be used during site characterization. The FSP also identifies the locations of samples and is designed so that a field sampling team unfamiliar with the site would be able to implement the specified procedures at designated locations. Investigation-derived waste sampling, management, and disposal issues are addressed in the waste management plan.
- **Quality Assurance Project Plan:** As the complementary half of the Sampling and Analysis Plan, the QAPjP describes the policy, organization, functional activities, and quality assurance/quality control (QA/QC) protocols necessary to achieve the data quality objectives dictated by the intended use of the data. Procedures for data validation are also discussed in the QAPjP.
- **Health and Safety Plan:** The purpose of the HSP is to outline the procedures for the protection of the health and safety of site personnel during RI field activities. Potentially hazardous operations and exposures are identified, and appropriate protective measures are specified in the HSP.
- **Community Relations Plan (CRP):** The CRP documents the community relations history and the issues of community concern as they relate to RI activities at the sites. It also defines mechanisms for the dissemination of related information to interested agencies and the community as such information becomes available, and provides a process for community input into the CERCLA remedy selection process.

#### **1.4            APPROACH TO PRESENTATION OF REMEDIAL INVESTIGATION ANALYTICAL RESULTS**

The project plans describe the procedures that were implemented in the field to gather representative soil and groundwater data. This section describes how the analytical soil and groundwater data will be presented in this RI report. The analytical results from the RI field work will be presented by site. For each site discussion, the results will be presented according to sampling activity. The sampling activities are based on historical site activities, expected pathways of chemical migration, or unexpected site conditions that would be assessed by unbiased sampling. The analytical results from each site activity

will be compared to the appropriate screening criteria. The following is a list of the screening criteria by site and environmental media.

Site	Screening Criteria	
	Soil	Groundwater
Burn Area - Site 13	Preliminary Remediation Goals (PRG) <sup>a</sup> for soil Total Threshold Limit Concentration (TTLC) Ambient Metals <sup>b</sup>	PRGs <sup>a</sup> for tap water
Building IA-24 - Site 17	PRGs <sup>a</sup> for soil TTLC Effects Range-Median (ERM) <sup>c</sup> Effects Range-Low (ERL) <sup>c</sup> Ambient Metals <sup>b</sup>	PRGs <sup>a</sup> for tap water
Building 7SH5 - Site 22	PRGs <sup>a</sup> for soil TTLC Ambient Metals <sup>b</sup>	PRGs <sup>a</sup> for tap water
Pistol Firing Range - Site 24A	PRGs <sup>a</sup> for soil TTLC Ambient Metals <sup>b</sup>	Not applicable
Building IA-20 - Site 27	PRGs <sup>a</sup> for soil TTLC	Not applicable

<sup>a</sup> PRGs - DTSC or EPA PRG, whichever is more conservative (EPA 1995).

<sup>b</sup> Ambient Metals - Metals concentrations calculated from analytical results from ambient soil samples located near the sites, but away from site activities (Appendix A)

<sup>c</sup> ERM and ERL - Only for Site 17 Scal Creek sediment and drainage ditch soil samples (Persuad 1992; MacDonald 1993; Long and Morgan 1990; and EPA 1989, 1992).

In general, chemical concentrations are compared to PRG values to identify potential human health concerns, to TTLC values to locate any hot spots (areas of unusually high concentrations), to ambient values to identify any metals concentrations that may be greater than concentrations of metals naturally occurring in soil, and to ERM and ERL values to identify potential ecological concerns. The chemicals exceeding these screening criteria are discussed in detail in the site-specific chemical characterization sections of this report.



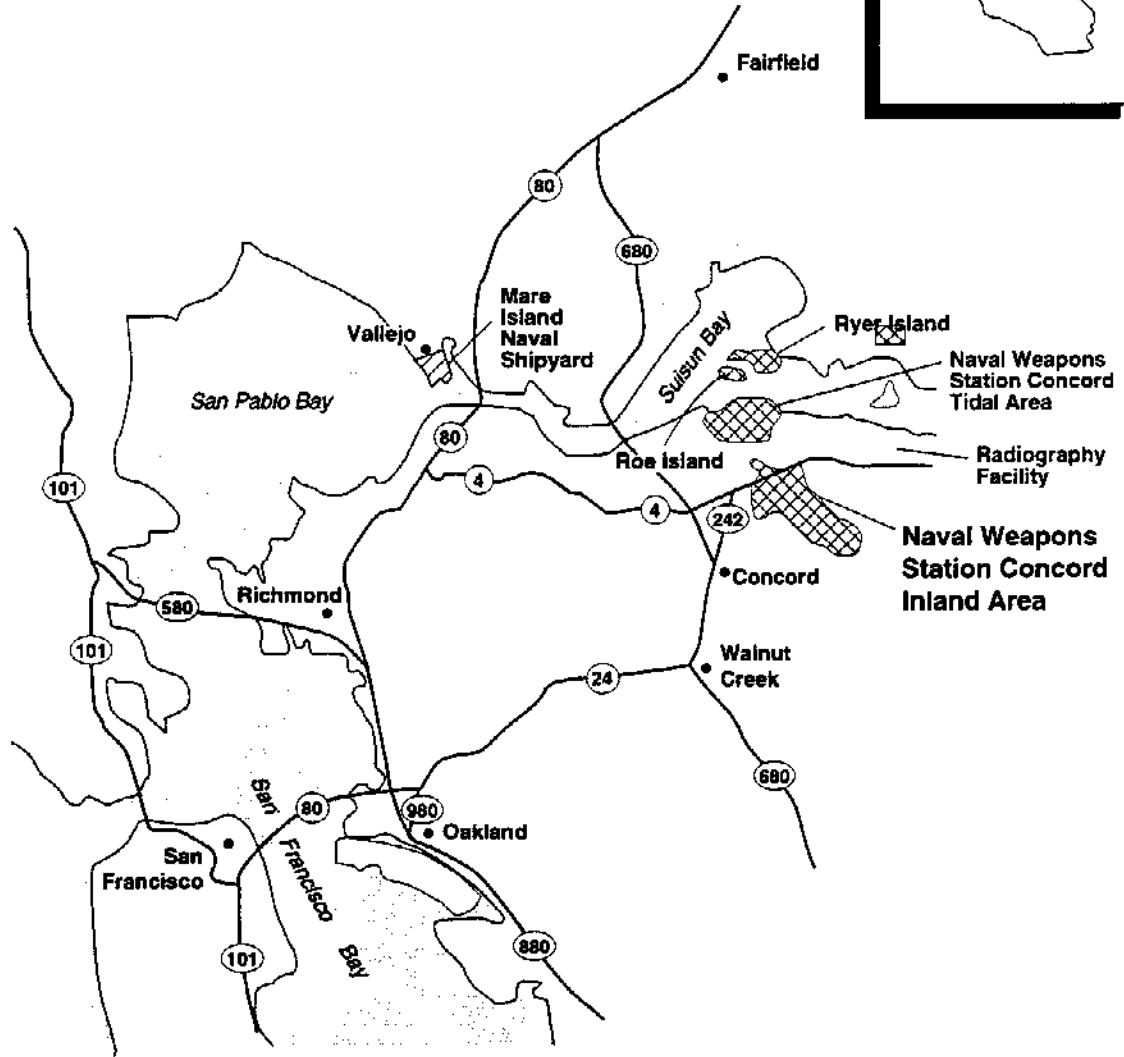
## 1.5

## REPORT ORGANIZATION

Subsequent sections of this RI report describe the field activities; site geology and hydrogeology; the nature and extent of chemicals in soil and groundwater; applicable regulations and remediation goals; potential human health or ecological concerns; the fate and transport of chemicals; and recommendations. Sections 1.0 through 4.0 of this report provide information applicable to all five sites. Sections 5.0 through 9.0 present the details of the field investigation and the analytical results for each of the sites. Sections 10.0 through 13.0 present the risk assessment, evaluation of site-specific chemical fate and transport of contaminants, and recommendations for the five sites. The figures and tables referenced in these sections appear at the end of each section. Detailed descriptions of Sections 2.0 through 13.0 of this RI report are provided below:

- Section 2.0, Environmental Setting, describes the NWS Concord land use, transportation, climate, physiography and topography, geology, hydrology, and ecological and biological resources.
- Section 3.0, Investigation Methodologies, describes the reconnaissance activities, the soil and groundwater investigation, the analytical program, and the data validation process.
- Section 4.0, Laws, Regulatory Guidelines, Applicable Criteria, and Preliminary Remediation Goals, describes potentially applicable laws and regulations governing environmental investigations at NWS Concord. This section also presents applicable or relevant and appropriate requirements (ARAR) and PRGs pertinent to the RI at the NWS Concord Inland Area.
- Section 5.0, Site 13 - Burn Area, discusses the site history, previous environmental investigations, physical characteristics, RI field activities, chemical characterization, and revised conceptual site model.
- Section 6.0, Site 17 - Building IA-24, presents the site history, previous environmental investigations, physical characteristics, RI field activities, chemical characterization, and revised conceptual site model.
- Section 7.0, Site 22 - Building 7SH5, presents the site history, previous environmental investigations, physical characteristics, RI field activities, chemical characterization, and revised conceptual site model.
- Section 8.0, Site 24A - Pistol Firing Range, presents the site history, previous environmental investigations, physical characteristics, RI field activities, chemical characterization, and revised conceptual site model.

- Section 9.0, Site 27 - Building IA-20, presents the site history, previous environmental investigations, physical characteristics, RI field activities, chemical characterization, and revised conceptual site model.
- Section 10.0, Human Health Risk Assessment, presents the screening-level human health risk assessment, based on PRGs, for all five sites.
- Section 11.0, Ecological Risk Assessment, presents an ecological risk assessment for Sites 13 and 17.
- Section 12.0, Contaminant Fate and Transport, presents an assessment of the fate and transport of chemicals in the soil at all five sites and the groundwater at Sites 13, 17, and 22.
- Section 13.0, Recommendations, presents recommendations for future investigation, remediation, or no-action alternatives for all five sites.



LEGEND:



WPNSTA Concord Property



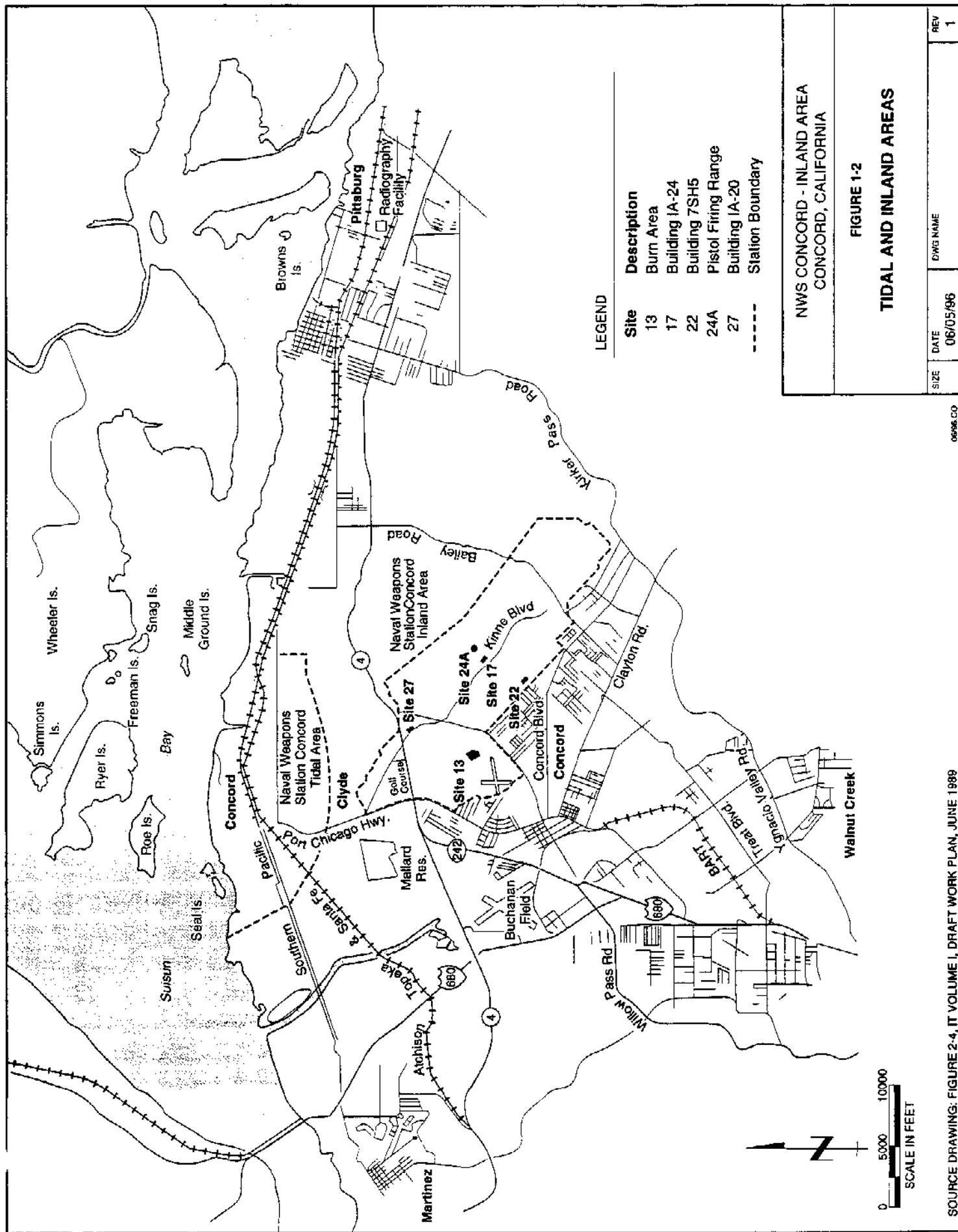
0 5 10  
SCALE IN MILES

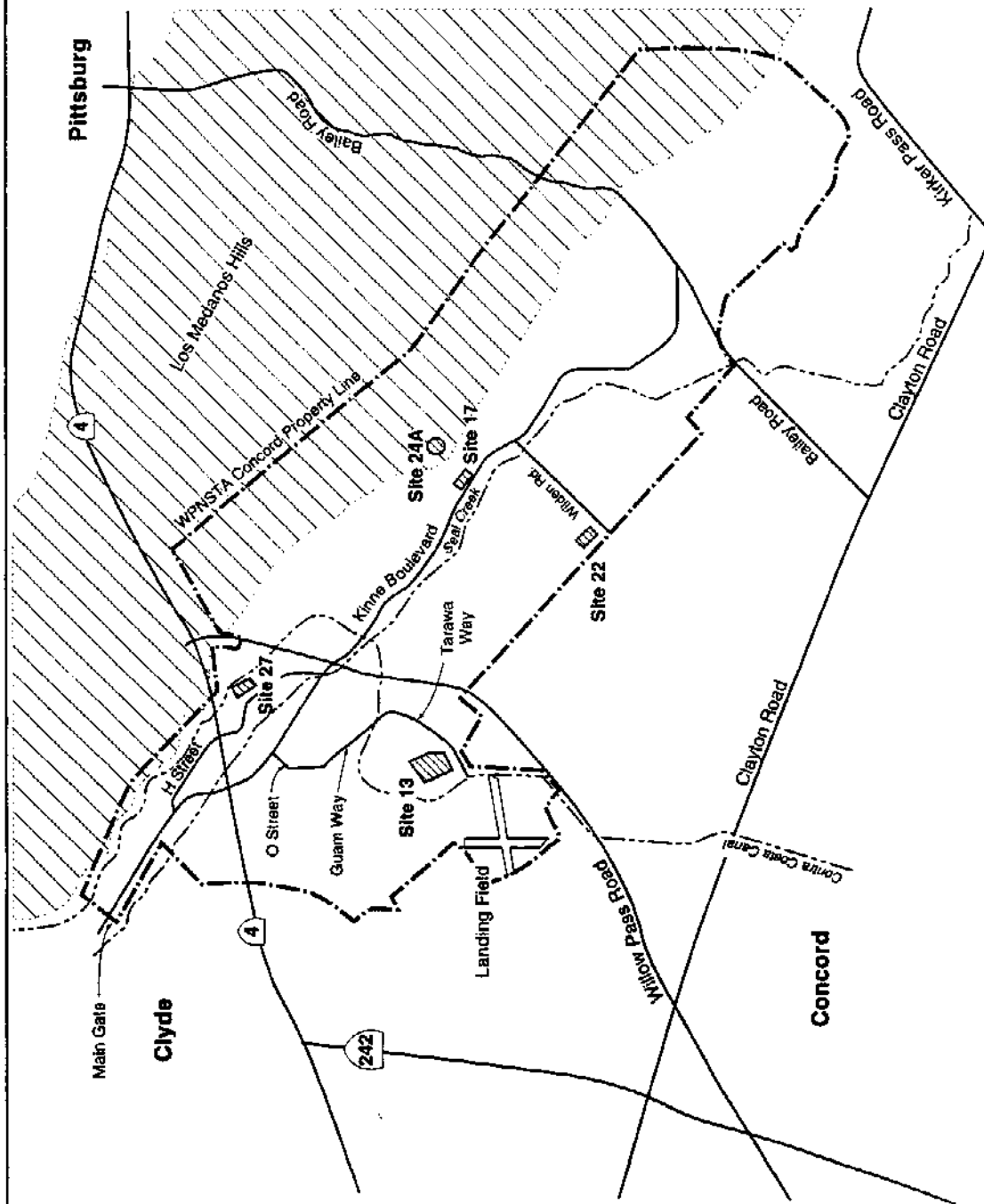
NWS CONCORD - INLAND AREA  
CONCORD, CALIFORNIA

FIGURE 1-1  
REGIONAL LOCATION MAP

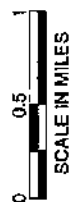
SIZE	DATE	DWG NAME	REV
	06/05/96		1

06/96.CO





Site	Description
13	Burn Area
17	Bldg. 1A-24
22	Bldg. 7SH5
24A	Pistol Firing Range
27	Bldg. 1A-20



NWS CONCORD - INLAND AREA  
CONCORD, CALIFORNIA

### FIGURE 1-3 INLAND AREA RI SITES

SIZE	DATE	DWG NAME	REV
	06/10/96		1

06/96/CC

## **2.0 ENVIRONMENTAL SETTING**

The following section presents the land use, transportation, climate, physiography and topography, geology, hydrology, and ecological and biological resources for the area in the vicinity of NWS Concord and within the Inland Area of NWS Concord.

### **2.1 LAND USE**

Land use in the vicinity of NWS Concord is diverse, characterized by a mixture of industrial, residential, agricultural, and open space zones (Figure 2-1). The Contra Costa County Protected Land Use Plan is intended to ensure that each of these four planning areas continues to develop unchanged (Naval Facilities Engineering Command [NFEC] undated).

Los Medanos Hills separate the Tidal and Inland Areas and are the site of the Los Medanos underground gas storage field. This land is privately owned and is leased to the Pacific Gas and Electric Company for deep-well gas injection. The land is also used for cattle grazing. Fifteen miles to the southeast of the station is the Mount Diablo State Park and State Game Refuge. This 7,004-acre preserve contains picnic facilities, campsites, and hiking trails.

NWS Concord is bordered on the south by residential sections of the city of Concord. These neighborhoods are made up of single-family, medium-density housing. Most of the housing dates from the mid-1950s. In addition, seven public schools and several parks are adjacent to the Navy property line. Steep slopes and access problems have prevented extensive development along Kirker Pass Road and in the hills northeast of NWS Concord. These areas are currently zoned for open space and agricultural land uses. The Concord Pavilion, a public entertainment facility, is located on Kirker Pass Road near the station's south boundary.

The Diablo Creek Golf Course occupies a 162-acre triangular parcel of land between State Route 4, Port Chicago Highway, and NWS Concord's administration/support complex (Figure 2-1). The city of Concord operates a large water treatment plant and the Mallard Reservoir just west of Port Chicago Highway.

Land to the north of State Route 4 and to the west of NWS Concord is zoned for industrial development. Several industrial firms have located there, particularly along Port Chicago Highway near the main gate of NWS Concord. TOSCO Refining Company and Monsanto Chemical Company have facilities along Solano Way near Waterfront Road.

Within NWS Concord, ammunition storage constitutes the largest single land use, and is maintained in five magazine groups and two groups of barricaded railroad sidings within the Inland Area (Figure 2-2). Various production facilities for the inspection and maintenance of ordnance are located throughout the Inland Area.

Support operations are located in a corner of the Inland Area northwest of State Route 4. These operations include the station's administrative complex, public works, supply, personnel support activities, and both bachelor and family housing. A portion of the data processing department is within the WQEC complex east of State Route 4. An abandoned airfield used for training forklift operators lies south of State Route 4. Approximately 1,000 acres of station land are leased for cattle grazing.

## **2.2 TRANSPORTATION**

Regional transportation near NWS Concord is diverse, and includes transport by land, water, and air (Figure 1-2). Three major transcontinental rail lines are present: the Atchison, Topeka and Santa Fe Railway; the Southern Pacific Transportation Company; and the Sacramento Northern Railroad (owned by Union Pacific). The county contains several interstate and state limited-access highways that generally follow the urban development patterns of the county. The major north-south Interstates are routes 80 and 680, while State routes 24 and 4 extend east-west. State route 242 runs north-south, connecting State route 4 and Interstate route 680. State route 4 is a limited access highway beginning at Interstate 80 near Hercules and extending eastward through NWS Concord. Bailey and Willow Pass Roads are secondary routes that originate in the city of Concord and extend northeastward toward the city of Pittsburg, passing through the Inland Area of the station. Port Chicago Highway begins as a commercial street in Concord, passes adjacent to the Inland Area, and continues through the Tidal Area, leading to the city of Pittsburg. The portion of Port Chicago Highway that passes through the Tidal Area is not open to the public, and access is controlled by NWS Concord. Three civilian airports are located

within a 1-hour drive of NWS Concord: San Francisco International Airport, Oakland International Airport, and Buchanan Field in Concord.

Separation of the Inland Area from the Tidal Area by the Port Chicago Highway requires the areas to be fenced separately, with each area having manned guard gates. A controlled-access road and a Navy-owned railroad run parallel to Port Chicago Highway between the Inland and Tidal Areas. Movement of people or materials between the areas requires crossing Port Chicago Highway between the controlled road and the main gate to the Inland Area.

An organized public transportation system is not available at NWS Concord. Consequently, private vehicles provide local transportation. During normal station operations, the majority of private vehicle traffic is concentrated in the Inland Support Complex. Access to this area is through the main gate or through secondary gates on Willow Pass and Bailey roads. The Willow Pass Road gate and Bailey Road gate operate only during weekday commute hours.

Most of the roads leading to the Inland Area sites are off of Kinne Boulevard, the primary road through the Inland Area. The majority of the study sites may be reached by two-lane, asphalt-capped, gravel or dirt roads. Depending on the season of the year, all-terrain vehicles may be required to reach some of the sites.

## **2.3 CLIMATE**

Prevailing winds blow from the west through the wind gap formed by San Francisco Bay and Carquinez Strait. As a result, the Pacific Ocean and Suisun Bay have a significant impact on the microclimate of NWS Concord and the surrounding vicinity. These westerly winds are particularly dominant during the summer months and minimal from November through February. Occasionally, the late spring and summer weather is influenced by a high-pressure ridge over the interior of California, with resulting high temperatures. Contra Costa County normally experiences dry, warm summers and moderately rainy winters. Wind directions and speed are monitored at a Pacific Gas and Electric power plant in Pittsburg, a few miles east of the facility. Velocity measurements are taken at 33 feet above ground surface. The wind blows from southwest to west-northwest at a mean wind speed of 12 miles per hour (mph) 65 percent of the time. Wind speeds exceeding 25 mph occur only 0.5 percent of the time, or about 44



hours per year (Table 2-1). Ground-level wind velocities at the various sites under study are generally 15 to 30 percent less than those measured at the power plant.

The mean annual precipitation for NWS Concord is 14 inches (E&E 1983). As in most of northern California, about 84 percent of the rainfall occurs from November through March. Regionally, rainfall may vary from 13 inches in the eastern portion of Contra Costa County to over 30 inches on the upper slopes of Mt. Diablo. Snow falls occasionally on Mt. Diablo, but the accumulation is small and lasts only a few days. Continuous rainfall recordings are available for Martinez, approximately 10 miles west of NWS Concord. Short duration rainfall events and peak watershed discharges may be estimated for the various study sites by multiplying Martinez precipitation data by a factor of 0.716; this factor represents the ratio of 1-day precipitation at Port Chicago to 1-day precipitation at Martinez (Lee and others 1986).

The average local temperature varies from 45EF in January to 75EF in August. In 1960, a high of 106EF in August and a low of 17EF in January were recorded. During a hard freeze in December 1972, the record low was 16EF. The average frost-free season is about 265 days.

The geographic and urban settings of the region make the area prone to urban air contamination problems. Inversion, an increase in ambient temperature with altitude, is a common occurrence. Temperature inversion prevents airborne contaminants from dispersing vertically in the upper atmosphere, causing concentrations at ground level to rise. The most common pollutants are sulfur dioxide, carbon monoxide, and particulates.

## **2.4                   PHYSIOGRAPHY AND TOPOGRAPHY**

NWS Concord lies approximately 10 miles west of the confluence of the Sacramento and San Joaquin Rivers. This confluence forms the Delta region, which contains more than 600 miles of interconnected and meandering tidal waterways.

Contra Costa County proper consists of four general physiographic regions: the highlands of the Coast Range, the intermountain valleys, the San Francisco Bay depression, and the Sacramento-San Joaquin Delta (NFEC 1979). The intercoastal highlands (Diablo Range) have smooth rolling hills and relatively

rugged mountains ranging from 100 feet above mean sea level (msl) along the San Francisco Bay depression to 3,849 feet above msl at Mt. Diablo.

The San Francisco Bay depression and intermountain valleys consist of nearly flat flood plains and low terraces with gently rolling fans and old terrace remnants adjacent to the uplands. Most of the low-lying, river-delta lands have been reclaimed by protective dikes and drainage ways to form islands ranging from 30 to 7,000 acres.

Except for a few small streams draining west into San Francisco Bay, the drainage of Contra Costa County enters the San Joaquin River, San Pablo Bay, or Suisun Bay to the north and east. Drainage from NWS Concord is almost exclusively to the north into Suisun Bay.

Physiography and topography of the Inland Area of NWS Concord is shown in Figure 2-3. Most of the western half of the Inland Area is characterized by gently sloping land designated as alluvial slope. Steeply sloping terrain, beginning at 100 feet msl and rising to more than 800 feet msl, form the northeast boundary of the Inland Area. These hills are composed of soft sandstone that erodes easily, making it poorly suited for construction.

Topography varies sharply in the entire Inland Area. The slope of the inland hills is steep, ranging from 15 to 30 percent. Steep slopes preclude construction in the upper elevations.

## **2.5 GEOLOGY**

The following section presents the geology in the vicinity of NWS Concord and the geology of the Inland Area.

### **2.5.1 Regional Geology**

The regional geologic features are a reflection of several northwest-trending fault systems that divide Contra Costa County into large blocks of rocks; up-thrown blocks form the hills and down-thrown blocks form broad lowlands floored with thick, unconsolidated, Pleistocene-age alluvial soils eroded from the upthrown blocks. The wetlands in the northern part of the region along Suisun Bay are underlain by

estuarine and fluvial deposits (NFEC undated). Figure 2-4 presents a simplified geologic map of NWS Concord with cross section A-A' showing the major geologic formations. The upthrust bedrock feature that topographically separates the Inland and Tidal Areas is typical of the geology of Contra Costa County.

The oldest formations are Tertiary sedimentary rocks exposed in Los Medanos Hills along the east side of NWS Concord (Dibblee 1981). Figure 2-4 shows the extent of geologic formations not only in Los Medanos Hills, but also in smaller exposures to the southwest. On the Inland Area side, the rock formations are composed of interbedded units of sandstone, siltstone, and shale. Sandstone is the most resistant unit, conspicuous in outcrops, and seems to constitute more than half the rock formations. Beds are typically steeply inclined. Jointing has combined with parting along bedding planes to facilitate weathering and development of boulder blocks in residual soil. The residual soil is susceptible to landsliding.

Nonmarine sedimentary rocks comprise the northern slope of Los Medanos Hills and the lowermost reaches on the Inland Area side. The upper slopes on the Inland Area side are characterized by older (mid-late Eocene) sandstones of the Markley group (Dibblee 1981). Surficial deposits of sandstone are unconformably underlain by a basement complex of sedimentary, igneous, and metamorphic rocks that form most of the northern half of the coastal hills and lie beneath Suisun Bay.

Figure 2-4 shows the two major faults known to exist in the NWS Concord area. The Concord fault passes through the city of Concord at a distance of approximately 2 miles from the southwest boundary of NWS Concord. The Concord fault is classified as active by federal, state, and local agencies and its activity is evidenced by fault creep, which causes offset curbs, pavement distress, and other damage. The Concord fault is a right-lateral strike-slip fault with rocks on the southwest side of the fault undergoing displacement to the northwest relative to rocks on the northeast side. The Concord fault is thought to be either the northwest extension of the Calaveras fault, the most seismically active fault in this part of California, or related to the Greenville fault that lies to the southeast of Mt. Diablo.

The main trace of the Clayton fault lies at the base of Los Medanos Hills, passing through NWS Concord in most places less than 1/2 mile from the installation's northeast boundary. The Clayton fault is classified as active or potentially active. Possibly related to faulting and fault displacement are several

lineaments that occur to the west of the main trace of the Clayton fault. The lineaments project northwesterly toward industrial facilities and magazines of the Inland Area (EDAC undated). The Clayton fault is most likely a dip-slip fault (one side is dropped down relative to the other side) and runs subparallel to the larger Concord fault. It is most likely dropped down to the southwest (Dibblee 1981). The Clayton fault may be related to a series of northwest-trending structural features that strike to the southeast, the Marsh Creek-Greenville fault and the Arroyo Mocha fault. A January 1980 earthquake, centered on the Marsh Creek-Greenville fault, resulted in up to 1 inch of right-lateral strike-slip displacement and up to 2 inches of local vertical slip on the Clayton Fault (EDAC undated).

Faults such as the Concord and Clayton commonly occur as zones of displacement, where more than one trace or segment of a fault may be present. Known as fault zones, these areas are very complex geologically. Faults and fault zones may be important pathways for the migration of groundwater and chemical compounds, if present.

### **2.5.2 Local Geology**

The geology of the Inland Area is shown in Figure 2-4. Consolidated Tertiary rock formations are exposed along the eastern edge of the Inland Area in Los Medanos Hills. The adjacent low lying flatlands are covered by a veneer of younger Quaternary Alluvium overlying basement rocks at depth. Older alluvium outcrops in the middle of the Inland Area in what has been mapped as a north-plunging anticline. The Clayton Fault has been mapped along the margin of Los Medanos Hills (Dibblee 1980a,b,c; 1981), and is considered potentially active (active within the last 25,000 years) by some geologists (Nelson 1993). This fault is most likely a dip-slip fault with the west side of the fault downdropped.

Groundwater beneath the Inland Area is commonly found in the coarser sand and gravel units of the unconsolidated alluvial deposits. Typically, groundwater has been first encountered at depths of approximately 30 to 50 feet, and under semiconfined to confined conditions.

A generalized hydrogeologic cross section (B-B') across the Inland Area was constructed while generating the conceptual site models and is included as Figure 2-5. (See Figure 2-4 for line of cross section B-B'.) The cross section was generated from available well and soil borings logs completed

during the SI and a hazardous waste disposal sites study (Lutton and others 1987). In addition, information from off-site construction projects and municipal wells was reviewed. Based on the available information, it is believed that the upper 30 to 80 feet of sediments consist of discontinuous sand and gravel layers surrounded by a silt and clay matrix. Depth to groundwater within these units is variable, and locally perched conditions appear to exist. A regionally continuous sand and gravel layer exists beneath the upper fine-grained sediments. Groundwater within this zone is under confined conditions, although it appears to be semiconfined to unconfined near the base of Los Medanos Hills near Site 17 (Figures 6-3 and 6-4).

## **2.6 HYDROLOGY**

The following section presents the hydrology for the vicinity of NWS Concord and the hydrology of the Inland Area.

### **2.6.1 Regional Hydrology**

The hydrology of the region can be separated into surface water and groundwater. Surface water hydrology is concerned with the streams, lakes, bays, and estuaries. The regional groundwater hydrology deals with both potable and nonpotable groundwater sources.

The drainage systems of the San Francisco Bay Area can be classified as (1) the Great Valley and Delta systems, (2) streams flowing into the San Francisco, San Pablo, or Suisun Bays, and (3) streams flowing directly into the Pacific Ocean. The Great Valley drainage includes all those streams flowing into the Sacramento and San Joaquin Rivers and drains approximately 59,000 square miles. Most of the runoff through the watershed is derived from melting snow that creates a peak flow around February. Another peak flow period in April to May is caused by heavy seasonal rains.

The Sacramento Basin, the northern portion of the Great Valley system, is the most important hydrologic basin in California. It drains more than 5,000 square miles of the northern central valley. Existing water supplies in the Sacramento Basin are heavily used, with the vast majority of water historically going to the agricultural sector (California Department of Water Resources [CDWR] 1983). Transfers of water,

including agricultural water, out of the Sacramento Basin account for well over half of the total water diverted from northern to southern California.

Four major rivers drain the basin: the Yuba, the Feather, the American, and the Sacramento. The first three of these rivers drain the northern part of the Sierra Nevada mountain range before emptying into the Sacramento River. Shortly after leaving the Central Valley, the Sacramento River drains westward into the Suisun Bay Delta. Numerous major reservoirs regulate the flow from this basin and provide storage, flood control, and hydroelectricity.

Entering Suisun Bay from the south is the San Joaquin River system. This watershed is the largest drainage basin in California, collecting surface and groundwater from 13,500 square miles. Average discharge of the river system in 1986 was approximately 10,000 cubic feet per second (cfs); however, for 8 months of the year it discharged less than 5,000 cfs (CDWR 1983).

Suisun Bay comprises the easternmost portion of the San Francisco Bay system. The eastern reach of the delta encompasses an area of about 738,000 acres consisting of 70 islands and tracts separated by 700 miles of waterways. Tributary streams that supply fresh water to the delta have helped to create and define its unique shape, that of a triangle with its base facing away from tidal waters instead of toward them, as is typical of coastal plain deltas. The Sacramento River provides more than 80 percent of the delta's inflow. San Joaquin River, Middle River, and Old River contribute the remaining 20 percent of inflow. More than 21 million acre-feet of water enters the delta during an average year. Discharge into Suisun Bay varies from under 10,000 cfs to as much as 600,000 cfs during major runoff events (CDWR 1987). Consumptive water use averages 1.6 million acre-feet yearly. Water export for the Central Valley Project and the State Water Project consume another 6.1 to 15.6 million acre-feet annually (CDWR 1988).

The south channel through Suisun Bay is part of the major shipping channel, connecting the Port of Sacramento to the Pacific Ocean. The remainder of the bay is shallow and is used by fishermen and inhabited by wildlife. During periods of high delta discharge in winter and spring, Suisun Bay, Carquinez Strait, and the easternmost reaches of San Pablo Bay become predominantly freshwater. During long periods of relatively steady flow of delta discharge in summer and fall, stratification and large horizontal salinity gradients develop with little net change in the salinity distribution.

California natural resources agencies currently maintain two programs for measuring surface water quality in the Sacramento-San Joaquin Delta and Suisun Bay region. The primary system is part of the CDWR statewide monitoring program that has been under way for several decades. The relevant sampling points are located in Suisun Bay and the delta. The second system was established by the State Water Project during the 1970s and focuses on water quality in the North Bay and delta region. Twenty-seven sampling stations have been established to monitor chlorophyll distribution, salinity, heavy metals, and benthic biomass. The marked influence of seawater is evident in the disparity in electrical conductance in the Bay versus the contributing rivers. Various water quality data including salinity and heavy metals concentrations are available for the delta region in the SI work plan (PRC/JMM 1992a).

The high density urbanization of the Bay Area causes a high demand for potable water. Potable water is provided almost exclusively from treated surface water sources in the vicinity. Groundwater, conversely, is used extensively for agricultural purposes, mostly for irrigation. According to the Contra Costa County Water District (CCCWD), groundwater constitutes from 5 to 10 percent of the potable water supply (Cummings 1996). Overdraft is currently not a problem in the Concord area, but is a significant concern in other parts of the San Francisco Bay Area. Salinity, caused by saltwater intrusion, is a major concern from an environmental standpoint and from the view of water supply. As such, extensive monitoring is conducted throughout the Sacramento-San Joaquin Delta and vicinity.

Some wells in the vicinity of the NWS Concord Inland Area are still used for water supply. These include several wells in the industrial complex area to the west, used primarily for process water and cooling water, and a series of potable water wells surrounding Mallard Reservoir to the northwest. CCCWD uses the groundwater from these wells on a daily basis to serve industrial clients. During droughts or emergencies, groundwater from these wells is also used to augment the normal aqueduct supplies of drinking water to the reservoir. Based on regional topography, the Tidal Area sites are estimated to be hydraulically downgradient from these wells near the Inland Area. Water levels in wells drilled by Lutton and others (1987) show a potentiometric surface that is comparable with a northward flow toward Suisun Bay.

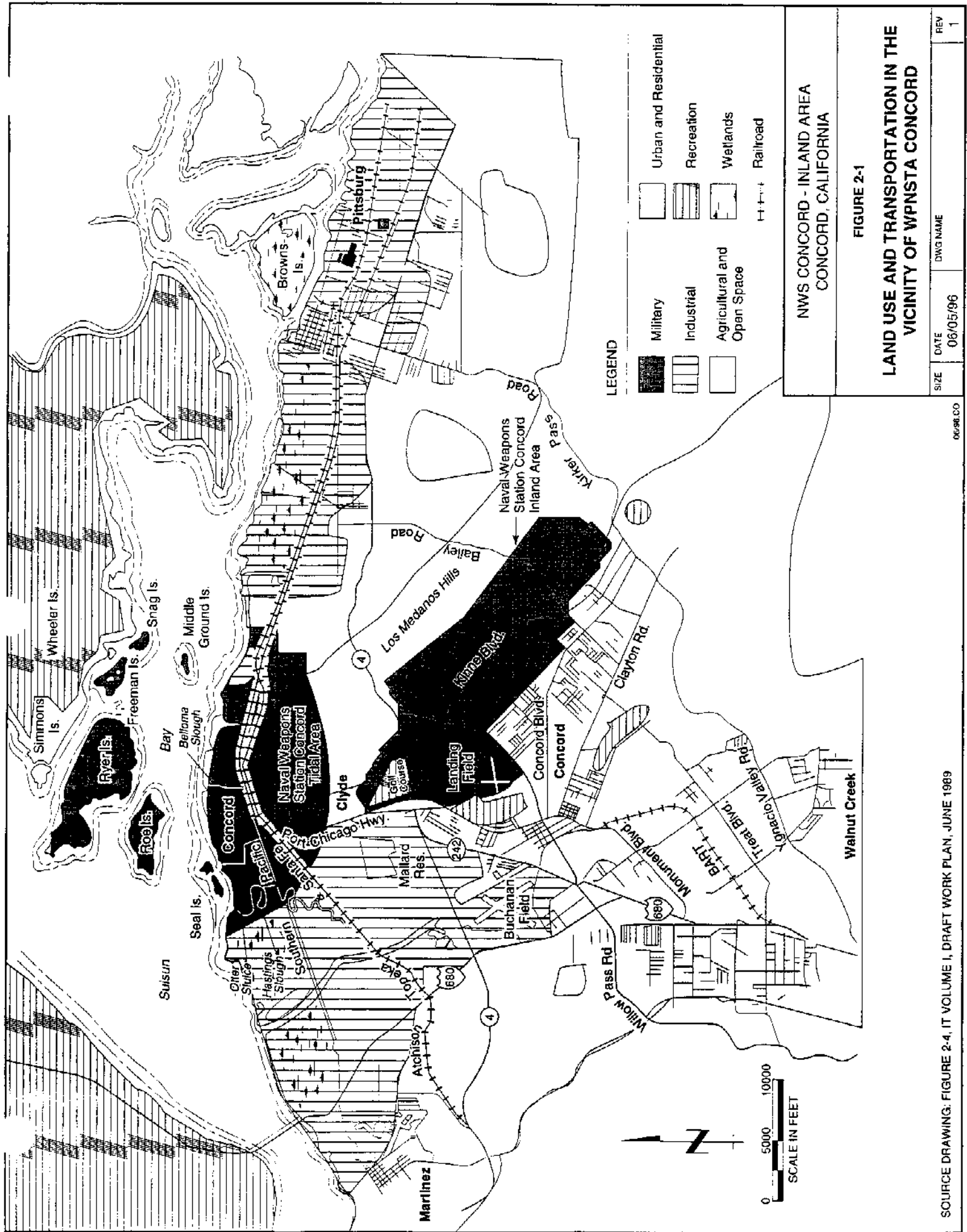
## **2.6.2 Local Hydrology**

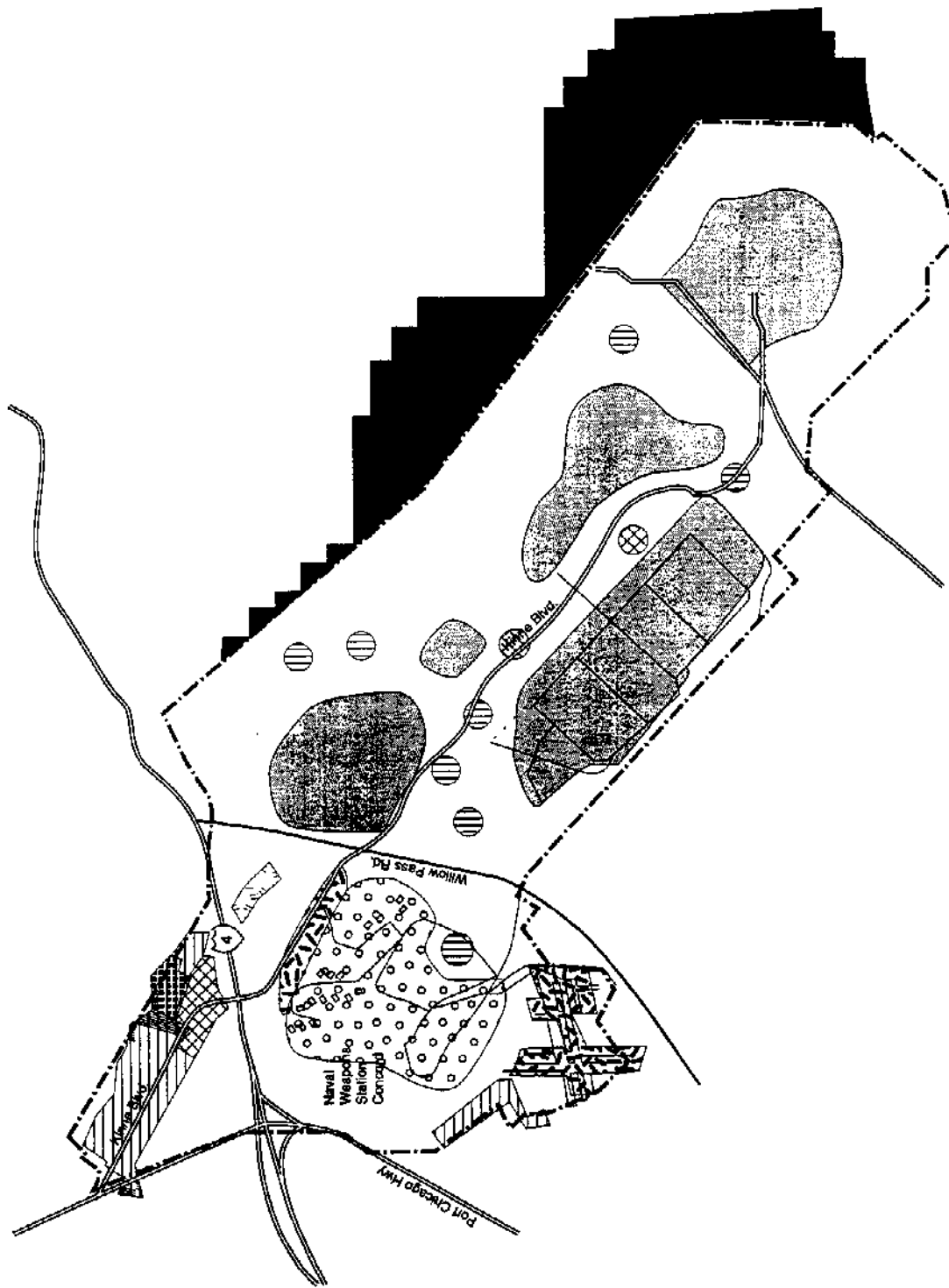
The Inland Area lies within the Mt. Diablo-Seal Creek hydrologic watershed. The principal drainage for this watershed is Mt. Diablo Creek, which is referred to as Seal Creek once it enters NWS Concord. Flow in Seal Creek along the Inland Area is intermittent, occurring primarily during the winter rainy season. Historical records show that some degree of flooding occurs during normal precipitation years along portions of the creek near the Tidal Area. However, the section of the creek that runs through the Inland Area is not a source of severe overbank flooding because the channel is deeply incised.

## **2.7 ECOLOGICAL CHARACTERIZATION**

Problem formulation in the ecological risk assessment (ERA) requires identification and evaluation of ecosystems at risk from adverse physical or chemical stressors. Previous Inland Area studies and recent qualitative site surveys provided information on the ecological habitats, potential receptors of concern, and types and extent of contamination for Site 13 - Burn Area. The initial assessment study report (E&E 1983), the SI report (PRC/Montgomery Watson 1993a), "A Natural Resources Survey Naval Weapons Station Concord, California" (Jones & Stokes Associates [Jones & Stokes] 1982), and a "Wildlife Survey of Concord Naval Weapons Station" conducted by the University of California Berkeley (UCB; Western Division, Naval Facilities Engineering Command 1994) were reviewed for summary information. The literature-based summary surveys reported biological data for the Inland Area of NWS Concord. Flora and fauna occurring at specific sites were not documented in detail, and were considered as a source of uncertainty when interpreting the survey results. RI surveys were conducted at Site 13 and involved reconnaissance rather than detailed species counts. Section 5.3.4 describes the ecology of Site 13.







# LEGEND

- Ammunition Storage (Magazine Groups)
- Administration
- Easement
- Transportation
- Public Works/Supply
- Research (WQEC)
- Support/Housing
- Ordnance Operations
- Break Bulk Loading (Railroad Sidings)

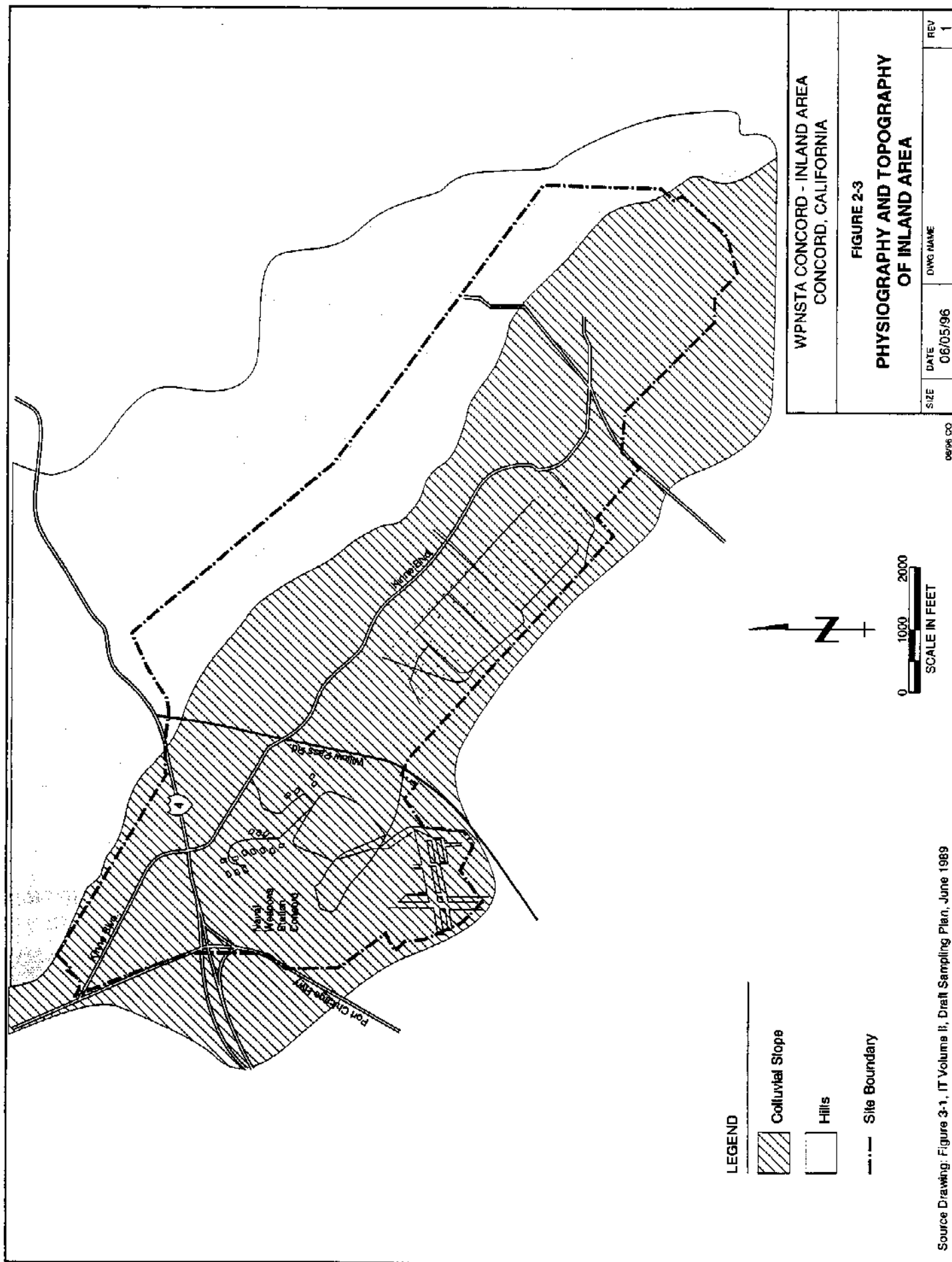
NWS CONCORD - INLAND AREA  
CONCORD, CALIFORNIA

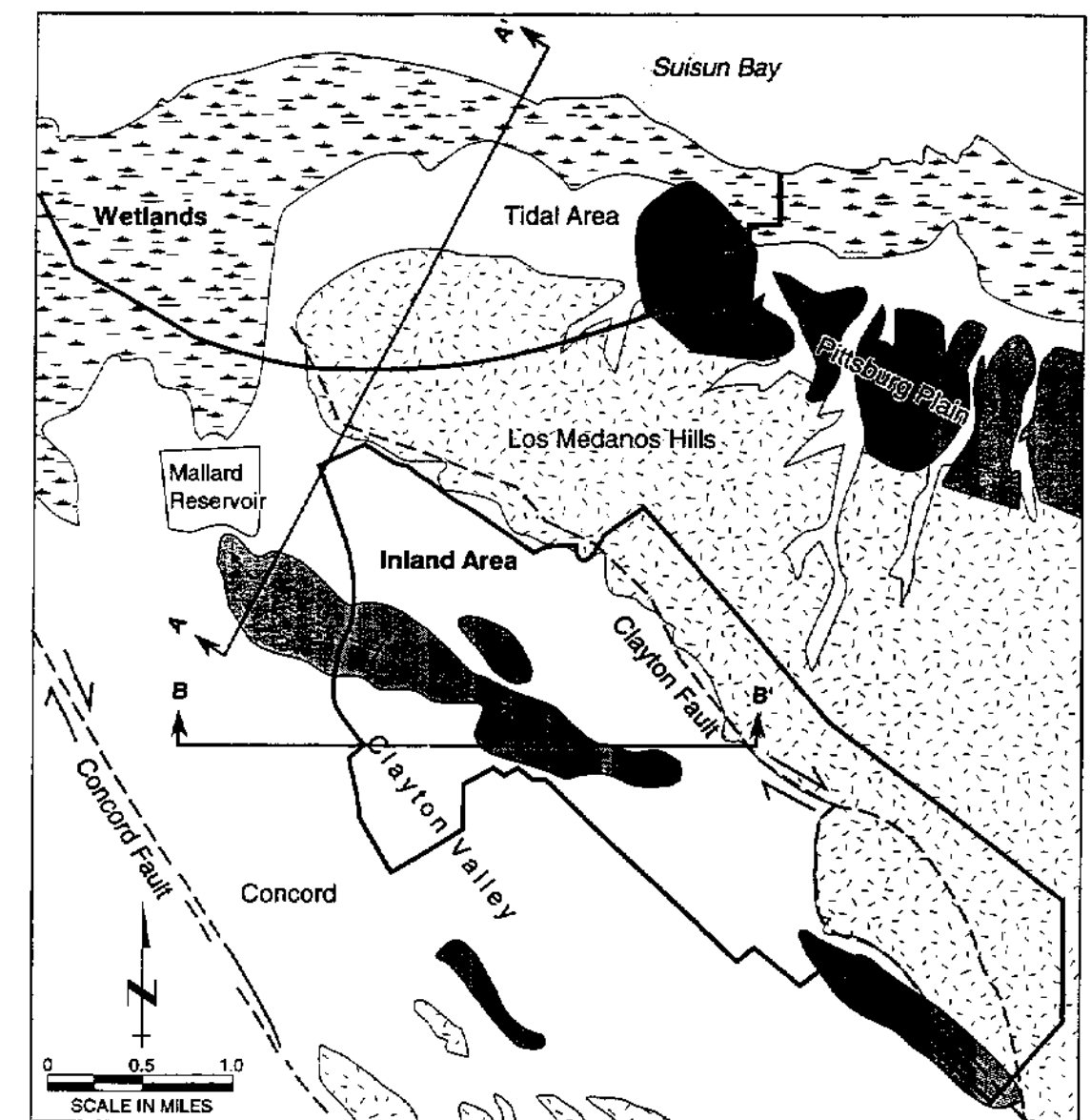
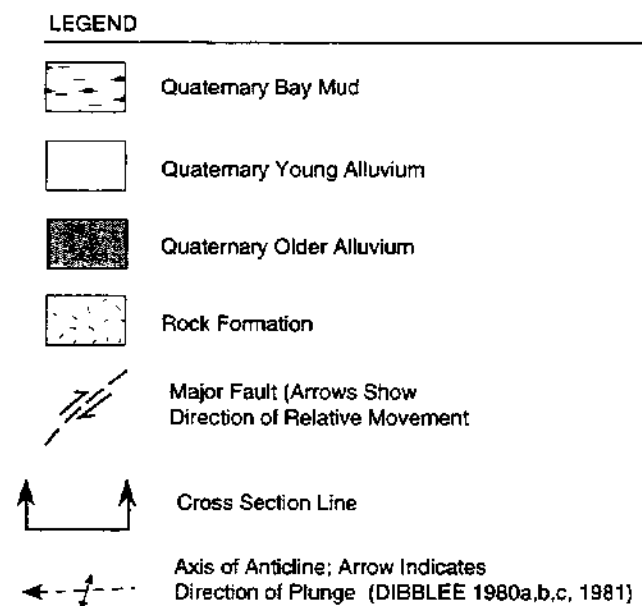
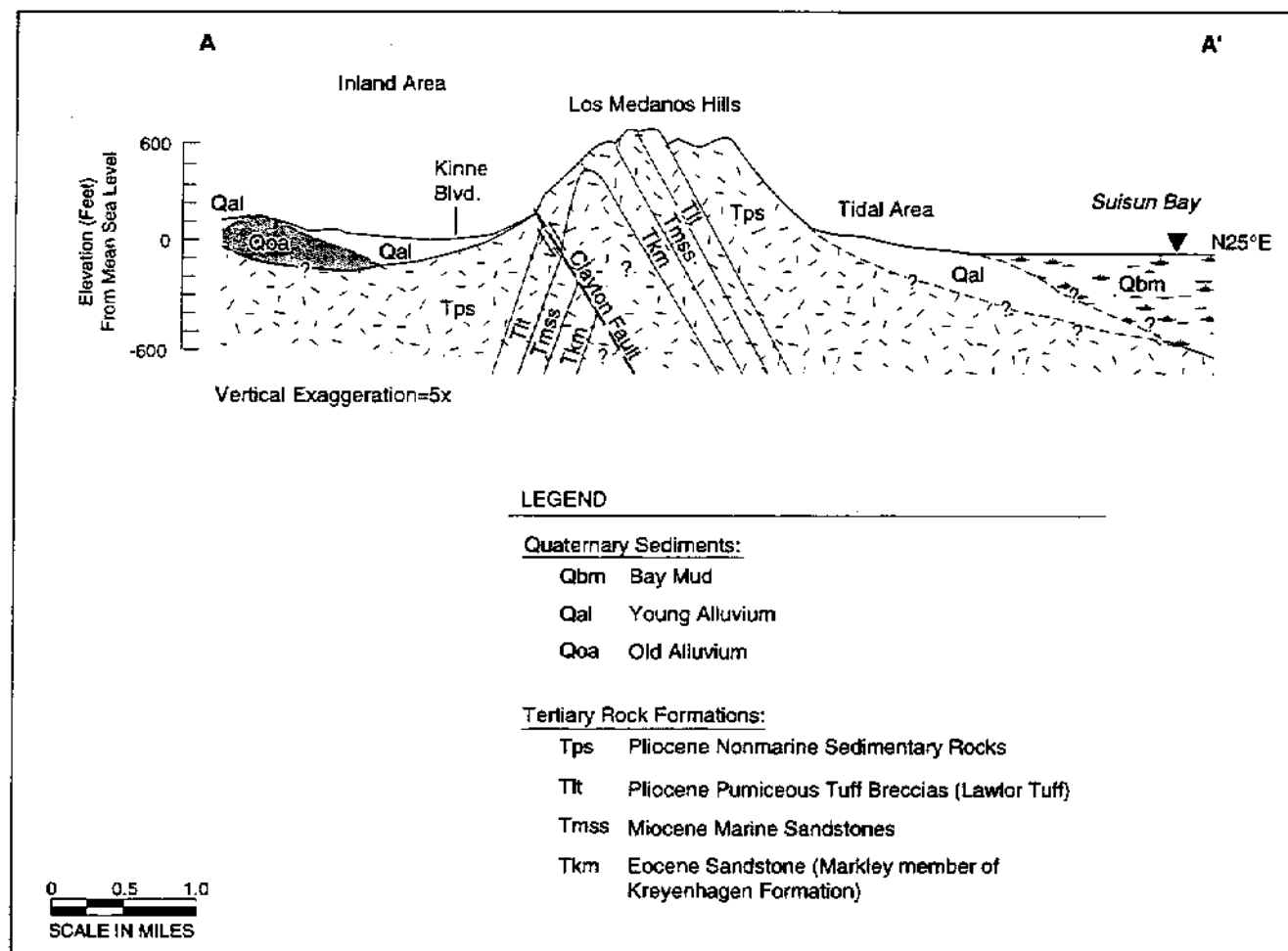
## FIGURE 2-2 LAND USE OF WPNSTA CONCORD INLAND AREA

SIZE	DATE	DWG NAME	REV
	05/05/96		1

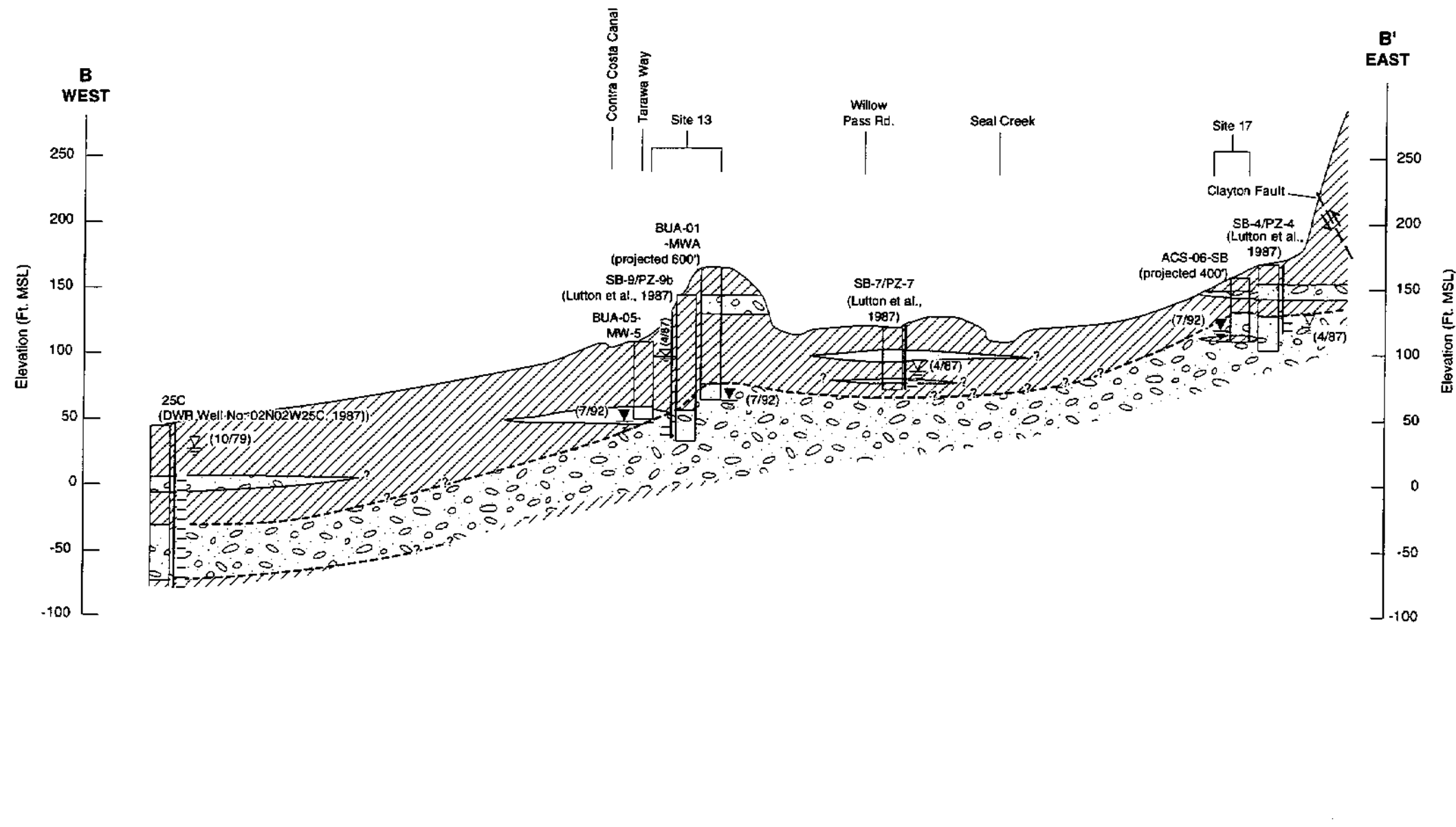
Source Drawing: Figure 3-1, IT Volume II, Draft Sampling Plan, June 1989

08/97 CO





NWS CONCORD - INLAND AREA CONCORD, CALIFORNIA			
FIGURE 2-4 GEOLOGY OF WPNSTA CONCORD AND CONCEPTUAL HYDROGEOLOGIC CROSS SECTION A-A'			
SIZE	DATE	DWG NAME	REV
06/96.CO	06/05/96		1



NWS CONCORD - INLAND AREA  
CONCORD, CALIFORNIA

FIGURE 2-5  
CONCEPTUAL HYDROGEOLOGIC  
CROSS SECTION B-B'

### **3.0 INVESTIGATION METHODS**

The following sections briefly describe the investigation methods employed during the RI. These methods include field sampling methods and data validation methods. The description of the field sampling methods include permitting, clearing utilities, surveying, soil sampling, and groundwater sampling. The discussion of data validation includes outlining the analytical program and data validation methods. A more detailed discussion of the sampling methods and procedures can be found in Section 7.0 of the FSP (PRC/Montgomery Watson 1995b). The use of a Geoprobe was a variance from the drilling methods specified in the FSP. The Geoprobe method is discussed in detail in Section 3.3.1.

#### **3.1 PERMITS, CLEARANCES, AND SURVEYING**

All required Contra Costa County permits for drilling soil borings and installing monitoring wells were obtained. Although NWS Concord is a CERCLA site and is exempt from obtaining permits from state and local entities, Contra Costa County insisted that the Navy file permits and pay fees to install groundwater monitoring wells. The county stated that it would revoke county licenses and prohibit all future drilling activities by the drilling company within Contra Costa County if the county's requirements were not met. To avoid delays, the Navy complied with the requirements. A notice of intent was filed with the California Department of Water Resources for the eight monitoring wells installed. Contra Costa County required one permit to drill all of the soil borings at the sites, and one permit for each of the eight monitoring wells installed.

Existing engineering plans, drawings, diagrams, and other information showing underground utilities were reviewed before drilling locations were finalized. Personnel from the NWS Concord Public Works Department (PWD) verified the drilling locations and checked with the installation planning department concerning any plans for future construction in the vicinity of the proposed locations. Private companies that run lines across the station were notified by the local commercial underground utilities locating service, and were asked to clear all drilling locations. The drilling locations at Site 22 - Building 7SH5 were finalized after a utility locating subcontractor identified the location of the UST piping.

Each soil boring, monitoring well, and test pit location was surveyed to determine its map coordinates using the California State Plane Coordinate System, North American Datum 1927. The monitoring well survey points were the north side of each uncapped well casing with the exception of ACSMW010, ACSMW013, and ACSMW014, which could not be accessed by the surveyors. For these wells, the top of the protective casing was surveyed and the difference between the top of the well casing and protective casing was subsequently measured. These elevation differences were subtracted from the surveyed elevation to calculate an elevation for the top of the well casing. Survey points were referenced to existing NWS Concord benchmarks. All surveying was conducted by a California-licensed surveyor.

### **3.2 SURFACE SOIL INVESTIGATION**

Surface soil samples were collected from the first half foot of soil at all five sites, both from sampling locations across the sites and from drainage ditches adjacent to the sites as described in the Field Sampling Plan (PRC and Montgomery Watson 1995b). The sample locations across the sites were determined based on site history and past use, with the exception of the grid samples at Site 13. The purpose of these grid samples was to collect soil samples unbiased by any knowledge of the site. The samples from the drainage ditches were collected to assess the potential of surface soil migration off site, via storm water runoff.

### **3.3 SUBSURFACE SOIL INVESTIGATION**

The subsurface soil investigation was conducted by collecting soil samples using drilling and excavating techniques. Three drilling methods were used at the sites, including air rotary casing hammer, hollow stem auger, and Geoprobe drilling. The drilling and excavation techniques, and the sites where they were used, are described in Section 3.3.1. Geoprobe drilling is described in greater detail because a thorough discussion of this method is not presented in the FSP. Section 3.3.2 discusses the trenching excavations.

Samples were collected from selected depths from all five sites for use in site characterization and geologic classification. Analytical parameters for each sampling location were selected based on results of previous investigations and knowledge of site history and past use. The specific geologic information and analytical results are presented in Section 5.0 (Site 13), Section 6.0 (Site 17), Section 7.0 (Site 22), Section 8.0 (Site 24A), and Section 9.0 (Site 27).

During the SI field sampling, soil samples were analyzed for total petroleum hydrocarbons - extractable (TPH-E). The analytical results from this method identified the type of fuel detected throughout the Inland Area sites as diesel. During the RI, the same sites were sampled for TPH-E. However, the results indicated that the fuel type detected was motor oil rather than diesel. This identification of different fuel types was a result of different target analyte lists used during the two phases of investigation. During the SI, the TPH present was most likely identified as diesel because motor oil was not requested as a target analyte. Samples were not analyzed for motor oil standard, so laboratory results would not have indicated whether the actual detection of fuel was closer to the motor oil range. During the RI, the target analyte list for TPH-E included motor oil and diesel. The chromatographic patterns for each sample have been reviewed and have shown a consistent pattern with the motor oil standard. All data have been validated and indicate that motor oil quantified during the RI is more representative of the type of fuel found at these sites than the diesel previously identified during the SI.

### **3.3.1 Drilled Soil Borings**

Drilling was conducted at all five sites to collect soil samples to characterize subsurface conditions, to estimate the vertical and horizontal extent of contamination in the unsaturated zone, and to install monitoring wells. At Site 13, soil borings were drilled using an air rotary casing hammer rig, because the protective casing used during drilling stops groundwater flowing from the lower, confined aquifer to the upper, unconfined aquifer. Hollow stem auger drilling was not used out of concern that if groundwater from the confined zone was under sufficient pressure, it could flow past the augers into the vadose zone and possibly aid migration of chemicals present in vadose zone soil. The air rotary casing hammer rig was used to drill three borings from 44 to 125 feet bgs, which were used to construct monitoring wells.

At Sites 17 and 22, soil borings were drilled using a hollow stem auger rig because the aquifers beneath the sites were unconfined, so the potential that confined groundwater could aid the migration of contamination - as expressed for Site 13 - was not an issue at these sites. Six borings were drilled at Site 17 from 30 to 35 feet bgs and five of the borings were used to construct monitoring wells. Three borings were drilled at Site 22 to 35 feet bgs and were used to construct three temporary monitoring wells.



Geoprobe drilling was conducted across all five sites, with soil samples collected from depths ranging from surface to 10 feet bgs. In addition, one sample was collected at 17 feet bgs from a boring at Site 13.

The sample locations across the sites were determined based on site history and past use, with the exception of the grid samples at Site 13. Grid samples were collected across the site to aid in the assessment of the extent of chemicals present at the site, and confirm that chemicals were localized in the trenches and gullies at the site.

The Geoprobe used during the RI field activities at NWS Concord is a vehicle-mounted, hydraulic-powered soil probing machine that uses static and percussion forces to advance soil sampling tools into the subsurface for sample collection. The soil sampling methodologies associated with the Geoprobe are discussed below.

The sampling tool is attached to the leading end of the drill rod and driven into the subsurface using the Geoprobe. Once the sampling tool was driven to the desired depth, the sampling tool and drill rod were pulled out of the ground and the soil sample removed from the sampling tool. The sampling tool was decontaminated prior to reuse. For additional sampling intervals, drill rods are connected in succession to advance the clean sampler to the next depth through the same borehole.

Two soil sampling tools, a large bore sampler (1-inch-inside-diameter [ID] by 24 inches long) and a macrocore sampler (1.75-inch-ID by 48 inches long) were used during RI field activities. The large bore sampler was used to collect soil samples from discrete sampling intervals, that is, to recover a soil sample at any prescribed depth. The large bore sampler remains completely sealed while it is pushed or driven to the desired sampling depth. This task is accomplished by a piston stop-pin at the top end of the sampler that holds a piston inside the sampler from moving while the sampler is driven to the depth desired. Once at the top of the sampling interval, the piston stop-pin is removed by means of extension rods inserted through the inside of the drill rods, enabling the piston to retract into the sample tube as the large bore sampler is advanced 24 inches to recover the soil sample. If additional sampling intervals were required, the large bore sampler was advanced through the same borehole to the next interval as needed.

The second type of sampling tool, the macrocore sampler, was used to collect continuous samples. The macrocore sampler was the first choice for sampling at NWS Concord because of its larger sampling

volume, larger sampling interval, and ease of use over the large bore sampler. At some sampling locations, especially in more saturated soils, sample recovery was poor using the macrocore sampler, so the large bore sampler was used. Sampling starts for the macrocore sampler at the ground surface with the open ended sampler. From the ground surface, the macrocore sampler is advanced 48 inches and retrieved from the hole with the first soil core. The next sampling interval is the next 48 inches as the sampler is advanced through the same hole.

Each sample collection device driven into the subsurface was lined with a clear acetate tube. The clear tubing (liner) allowed visual inspection of the soil core prior to determining the sample interval to be collected. Once the sampling tool was removed from the borehole and disassembled, the liner containing the soil core was extracted from the sampler. The liner was then cut at the desired soil sample interval for chemical or physical analysis. The samples cut from the liner were covered at both ends with Teflon squares and plastic end caps; labeled and placed in a cooler containing ice; and sent to a laboratory for analysis. A new acetate liner was used for each soil sampling interval. The soil in the liner was screened with a micro-tip photoionization detector (PID) while cutting the liner to measure any volatile constituents present, and then was logged by a geologist using the Unified Soil Classification System (USCS).

### **3.3.2 Trench Excavations**

Twenty-four trenches were excavated to 5 feet bgs at Site 13 (where soils appear to be stained), to aid in the characterization of debris and chemicals at the site. The trenches were located in the gullies and depressions where burning or ordnance and fire training activities have occurred. Each trench was excavated to native material using a backhoe. Trenches were excavated in order to investigate a larger portion of the site than would be possible with shallow borings. Because the past burning activities resulted in visibly stained soil, the areas of greatest apparent contamination were identified and sampled during the trenching activities. Three samples were collected from each trench and the analytical parameters were selected based on results of previous investigations and knowledge of site history and past use.

One trench was excavated at Site 22 in the area identified as a disposal pit. Twenty samples were collected from the floor and walls of the excavation. The alleged pit was believed to have been

backfilled, so excavation of the fill was necessary in order to sample the native soil. The excavation was backfilled with clean fill, and the soil removed during excavation was disposed as investigation-derived waste (IDW) according to the waste management plan (PRC 1995a).

### **3.4 GROUNDWATER INVESTIGATION**

The initial stage of the groundwater investigation consisted of installing permanent and temporary monitoring wells. The final stage of the groundwater investigation included sampling these new monitoring wells and existing monitoring wells. The following sections describe the groundwater investigation in more detail.

#### **3.4.1 Monitoring Wells**

Eight permanent groundwater monitoring wells were installed at Site 13 (three wells) and Site 17 (five wells). At Site 22, three soil borings were drilled and slotted polyvinyl chloride (PVC) pipe was inserted into the borings to prevent the side wall collapse. Grab groundwater samples were collected from these temporary wells. The soil borings were then backfilled with a Portland cement and bentonite grout mixture, as required by the Contra Costa County Department of Health Services. Temporary wells were used at Site 22 because few chemicals other than TPH were detected during the SI. In accordance with the work plan, if groundwater contamination was detected, permanent wells were to be installed (PRC and Montgomery Watson 1995a). In addition, one monitoring well was installed at Site 13 during the SI and four monitoring wells were previously installed by UNOCAL adjacent to Site 13. The information collected from these new and existing wells was used to characterize the hydrogeology and chemicals present at these sites. As noted in Section 3.3.1, soil samples were collected at selected depths from the new monitoring well boreholes to assist with site characterization and geologic classification. The construction logs for the new monitoring wells are presented in Appendix G. Based on the RI results, four monitoring wells were installed and sampled in January 1997. The details of the additional investigation are presented in the Site 22 work plan (PRC 1996e).

### **3.4.2 Groundwater Sampling**

Groundwater samples were collected from the 11 new monitoring wells at Sites 13, 17, and 22, and the five previously installed monitoring wells at Site 13. Two sampling rounds were conducted three months apart at the permanent wells at Sites 13 and 17. The temporary wells at Site 22 were sampled once and then were backfilled with a Portland cement and bentonite grout mixture, as required by the Contra Costa County Department of Health Services.

Analytical parameters for these sites were selected based on previous investigations and knowledge of the site history and past use. The specific hydrogeologic information and analytical results are presented in Section 5.0 (Site 13), Section 6.0 (Site 17), and Section 7.0 (Site 22).

## **3.5 ANALYTICAL PROGRAM**

The analytical program used for the NWS Concord Inland Area sites was designed to provide data of known quality. To achieve this goal, documented procedures were followed for the identification and documentation of all samples collected, containerization and preservation of all samples, sample custody and shipment control, internal quality control checks for field and laboratory analyses, data reduction and reporting, and data validation. Each of these procedures is described in the following subsections.

### **3.5.1 Identification and Documentation of Samples**

The first steps after a sample is collected are to assign the sample a number, label the sample container or containers, and document the collection of the sample. The sample numbering scheme was developed to be compatible with both the Navy and laboratory computerized database management systems. The numbering scheme allowed each sample to be uniquely identified and provided a means of tracking the sample from collection through analysis. The sample numbers identify the site, location of the boring, and the type of sample (sediment, soil, groundwater, or other). The numbering schemes used for all areas of NWS Concord are consistent.

The numbering scheme does not provide the laboratory with any information that could bias the reported results, which is especially important for field quality control (QC) samples. The procedures for

numbering the field QC samples (field duplicates, equipment blanks, and trip blanks) are described in Section 3.5.1.2. The other QC samples collected for this project were matrix spike/matrix spike duplicate (MS/MSD) volumes. The MS/MSD samples are required by the laboratory to measure precision and accuracy of the analytical methods. However, the MS/MSDs are not considered unique samples, and the extra sample volumes were numbered with the identical sample number as the original sample.

Once the sample number was chosen, it was recorded on sample labels, field tracking sheets, chain-of-custody forms, and other records documenting sampling activities including the field logbook.

#### **3.5.1.1 Phase I RI Location Identification System**

The location identification system consisted of three parts: (1) the RI site, (2) the location type (for example, soil boring or monitoring well), and (3) the specific location (for example, grid node or purposive location). Examples of the location identification system and each of its four parts are presented below:

<b>RI Site Abbreviation</b>	<b>Location Type Abbreviation</b>	<b>Specific Location</b>
BUA (Site 13, Burn Area)	SB (soil boring)	A01
ACS (Site 17, Bldg. IA-24)	SL (sediment)	B02
7SH (Site 22, Bldg. 7SH5)	SW (surface water)	C05
PFR (Site 24A, Pistol Firing Range)	TP (trench excavation)	D15
MTL (Site 27, Bldg. IA-20)	MW (monitoring well)	003

The "RI Site Abbreviation" is a three-letter code identifying the RI site. The "Location Type Abbreviation" is a two-letter code for the type of location. The "Specific Location" is a three-digit number or three-character code used to identify a specific grid or purposive sampling location. For example, grid node A01 would be located at the intersection of column A and row 01. Purposive and trench pit locations were identified consecutively. Samples collected at different times from the same

location (for example, surface water) were differentiated by the date of collection and the sample identification number.

All locations were recorded on appropriate forms during field activities to identify the location corresponding to the sample sent to the laboratory.

### 3.5.1.2 Phase I RI Sample Identification System

The sample identification system consisted of four parts: (1) the CTO number, (2) the RI site from which the sample was collected, (3) the sample type, and (4) the sample number. Examples of the sample identification system and each of its four parts are presented below:

CTO Number	RI Site Abbreviation	Sample Type Abbreviation	Sample Number
303	BUA (Site 13, Burn Area)	SS (surface soil)	001
303	ACS (Site 17, Building IA-24)	GW (groundwater)	002
303	7SH (Site 22, Building 7SH5)	SW (surface water)	003
303	PFR (Site 24A, Pistol Firing Range)	SD/SL (sediment)	004
303	MTL (Site 27, Building IA-20)	SB (soil boring)	005

The "RI Site Abbreviation" remains the same for both the location and sample identification system. The "Sample Type Abbreviation" is a two-letter code for the type of sample collected. The "Sample Number" is a three-digit sequential code for each type of sample at each site. Each sample type (soil sample, surface water sample, sediment sample, and groundwater sample) was numbered sequentially. Field QC samples (trip blanks, duplicates, and equipment blanks) were numbered sequentially to ensure that all samples were submitted blind to the laboratory. For example, a trip blank sent to the laboratory with monitoring well samples collected from Site 13, the Burn Area, was identified as 303BUAGW020 (the last sample collected that day would have been 303BUAGW019). Groundwater samples analyzed for MS/MSD were noted in the remarks section on the chain-of-custody forms.

### **3.5.2 Sample Analysis, Containerization, and Preservation**

Samples were placed in pre-preserved containers appropriate for the intended analysis. All soil and water analyses were conducted at an off-site analytical laboratory. A summary of sample containers, holding times, and preservative requirements for all soil and water sampling parameters is presented in Tables 3-1 and 3-2. All holding times were met because the samples were sent to the laboratory via courier.

### **3.6 DATA VALIDATION**

Data validation is a systematic process for reviewing and qualifying data against a set of criteria to provide assurance that the data are adequate for their intended use. This is accomplished by reviewing and evaluating all analytical data against precision, accuracy, representativeness, completeness, and comparability (PARCC) criteria. The laboratory analytical data generated during the NWS Concord RI were validated according to procedures outlined in the *National Functional Guidelines for Inorganic Data Review* (EPA 1994a), *National Functional Guidelines for Organic Data Review* (EPA 1994b), and *NWS Concord, Inland Area Sites QAPjP* (PRC/Montgomery Watson 1995c).

The scope of data validation encompassed 378 environmental samples that were collected between February 1995 and January 1996. The analytical program included the following analyses: Contract Laboratory Program (CLP) volatile organic compounds (VOC); CLP semivolatile organic compounds (SVOC); low detection limit SVOC; CLP pesticides and PCBs; low detection limit pesticides and PCBs; inorganic compounds (including mercury and cyanide); hexavalent chromium; TPH-purgeables (TPH-P) and TPH-E; dioxins; total organic carbon; moisture content; bulk density; specific gravity; permeability; sulfides; pH; salinity; anions; alkalinity; nitrate/nitrite; surfactants (total dissolved solids [TDS]); and total suspended solids (TSS). The analytical methods and references are listed in Tables 3-3 and 3-4.

#### **3.6.1 Validation and Verification Methods**

The validation and verification of the data generated during field activities is essential to ensuring data of defensible and acceptable quality. Data values that are significantly different from the population are referred to as "outliers." Outliers can result from improper sampling or analytical methodology, hot

spots, matrix interferences, data transcription errors, or calculation errors. Outliers resulting from errors found during data verification were identified and corrected; those that could not be attributed to analytical, calculation, or transcription errors were reported in the case narrative section of the analytical report. Additional verification methods for field and laboratory activities are presented in the following two subsections.

#### **3.6.1.1 Field Data Verification**

Field personnel reviewed field data to identify inconsistencies or anomalous values. Any inconsistencies discovered were resolved immediately, if possible, by seeking clarification from the personnel responsible for data collection. All field personnel were responsible for following the sampling and documentation procedures described in the FSP to ensure that defensible and justifiable data are obtained.

#### **3.6.1.2 Laboratory Verification of Data**

Laboratory personnel assessed the data at the time of analysis and reported, through a review of raw data, any nonconformances in analytical method protocols. Detailed procedures for laboratory validation and corrective action are described in the laboratory's quality assurance (QA) plan. The laboratory QA plan discusses sample control, methods of analyses, calibration procedures, document control, QC, QC checks, QA, corrective actions, and data review.

#### **3.6.1.3 Analytical Data Validation**

During the validation process, all results were identified as either acceptable for use, estimated and acceptable for limited use, or rejected and unacceptable for use. Results considered rejected were retained in the database but were not used in quantitative evaluations. Estimated and rejected data can result from improper sampling or analytical methodology, matrix interferences, errors in data transcription, and changes in instrument performance. Erroneous results found during data validation were identified and corrected. Validation methods for field and laboratory data are presented below.



Data validation was performed by a subcontractor independent of the project laboratory. Data validation was performed by the following firms: Maxwell/S-Cubed, Alexandria, Virginia; and ICF Kaiser Engineers, Inc., San Francisco, California.

The validation procedure for non-CLP methods includes (1) reviewing the requirements of the analytical method and the project QAPjP, (2) reviewing the data package to ensure that the requirements of the analytical methods and the QAPjP were met, and (3) reviewing the data package against applicable criteria from the EPA functional guidelines. Although the functional guidelines do not specifically address analyses other than CLP methods, the general concepts presented in the guidelines were applied to the non-CLP analytical methods.

Specific causes of rejected and estimated data and quality control criteria (QC) are discussed in detail in the Quality Control Summary Report, Appendix I.

**Cursory Data Validation** - Cursory validation was performed on all data summary packages for analysis of soil and groundwater samples by CLP and non-CLP methods. The data reviewer was required to notify TtEMI and request any missing information needed from the laboratory. The elimination of data from the review process was not allowed. All data were continued through the validation process and qualified and requalified as many times as required if they failed to meet the established criteria. Data summary packages consist of sample results and QA/QC summaries (equivalent to CLP Forms I through X for organic analyses, and Forms I through XIV for inorganic analyses), including calibration and internal standard data. There are no guaranteed minimum number of samples for a sample data group; however, the maximum number of samples did not exceed 20.

**Full Data Validation** - Full validation was performed on data packages for analyses of soil and groundwater samples by CLP and non-CLP methods. The data reviewer was required to notify TtEMI and request any missing information needed from the laboratory. The elimination of data from the review process was not allowed. All data were continued through the validation process and qualified and requalified as many times as necessary if they failed to meet the established criteria. Full validation was performed on approximately 10 percent of the sample data group. Data packages consist of sample results, QA/QC summaries (equivalent to CLP Forms I through X for organic analyses, and Forms I through XIV for inorganic analyses), and all raw data associated with the sample results.

### 3.6.2 Data Validation Criteria

The QC criteria reviewed for both cursory and full validations are as follows:

- For CLP organic analyses: holding times, calibration, gas chromatograph tuning, internal standard performance, blanks, surrogate recovery, target compound list (TCL) identification, compound quantitation and reported detection limits, tentatively identified compounds (TIC), MS/MSD recovery, blank spike or laboratory control sample recovery, overall assessment of data for a sample delivery group (SDG), and field duplicate sample analysis.
- For CLP inorganic analyses: holding times, calibration, blanks, interference check sample (ICS), laboratory control sample, sample result verification, MS/MSD sample analysis, field duplicate sample analysis, inductively coupled plasma (ICP) serial dilution, graphite furnace atomic absorption, QC, and overall assessment of data for an SDG.

The Inland Area project personnel reviewed the data validation reports from the validation subcontractor to assess whether chemical measurement data quality objectives (DQO) were met and to determine whether the data are usable for their intended purpose. The details of the data validation process are discussed in the Quality Control Summary Report presented in Appendix I.

### 3.7 QA/QC FIELD PROCEDURES

Field QA/QC samples were collected for laboratory analysis to evaluate sampling and analytical precision, accuracy, and representativeness. The QA/QC samples were consistent with guidelines presented in the Navy QA/QC requirements (Naval Energy and Environmental Support Activity [NEESA] 1988). Additionally, the QA/QC program, as presented in this section, meets the guidelines presented in the appropriate regulatory guidance (EPA 1990b).

**Field Duplicate Samples** – Field duplicate samples were collected at the same time and from the same sampling matrix as the original sample, but were submitted to the laboratory separately to assess the consistency of the overall sampling and analytical system. Field duplicates were analyzed for the same constituents as the original sample at a rate of 10 percent. The 10 percent basis was determined separately for each sample matrix and did not include the QC samples. The samples were collected,

numbered, packaged, and sealed in the same manner as other samples and submitted blind to the laboratory.

**Laboratory Split Samples** - Sample locations in the Burn Area (Site 13) were selected for collecting split samples for analysis of SVOCs (using low detection limits) and for standard CLP analytical methods. In addition, split samples were collected for rinsate water samples (collected approximately every 2 days).

**Reference Samples** - Samples were collected to evaluate interlaboratory analytical precision and accuracy and to serve as external QA samples. These referee duplicate samples were collected and sent to a referee QA laboratory only when regulatory agencies collected split samples. The collection of referee duplicates or referee split samples was identical to the sampling method associated with the field duplicate samples described above.

**Source Water Blank** - One source water blank sample was collected from the domestic base water source to determine quality parameters. The source water sample was analyzed for the same parameters as the samples collected during the Phase IA RI. The source water was used throughout the investigation for the detergent wash water for decontamination procedures throughout the investigation.

**Equipment Rinsates** - Equipment rinsates are used to evaluate sampling device cleanliness. The equipment rinsates were collected after a sample collection device, such as a split-spoon sampler or bailer, was subjected to standard decontamination procedures. Appropriate water for the intended analysis was poured over or through the sampling device, collected in a sample container, and sent blind to the laboratory for analysis. High performance liquid chromatography water or equivalent organic-free water was used to create samples for organic analyses, and deionized water was used to create samples for inorganic analyses. The equipment rinsate samples were collected on a daily basis.

**Trip Blanks** - Trip blanks are used to identify possible sample contamination originating from sample transport, shipping, or site conditions. Trip blanks were prepared in the laboratory using organic-free water. They were then shipped with the sample containers to the field, stored with the field samples, and returned to the laboratory with the samples scheduled to be analyzed for VOCs. One trip blank

accompanied each cooler containing VOC samples and was analyzed for VOCs, because these compounds have the greatest potential for cross contamination.

**Quality Control Practices** - Field measurements were obtained while collecting water samples as part of the sampling program. These measurements and the associated QC practices included:

- pH, specific conductance, turbidity, and temperature - measured in duplicate 10 percent of the time
- Water levels - measured in duplicate 10 percent of the time.

Subcontractors conducting field activities followed QC practices as provided in their standard operating procedures (SOP). Results from field measurements and QC checks were compared to the PARCC criteria presented in Section 3.0 of the QAPjP.

TABLE 3-1

**INLAND AREA REMEDIAL INVESTIGATION  
SAMPLE CONTAINER, HOLDING TIMES, AND PRESERVATIVE  
REQUIREMENTS FOR SOIL SAMPLES**

Parameter	Method Number <sup>a</sup>	Sample Container	Preservative	Holding Time <sup>b</sup>
<b>ORGANIC ANALYSES:</b>				
Volatile Organic Compounds (VOC)	CLP <sup>c</sup>	6-in. sleeved No headspace	Cool, 4°C	14 days
Semivolatile Organic Compounds (SVOC)	CLP	6-in. sleeve	Cool, 4°C	14 days/40 days
Organochlorine Pesticides and Polychlorinated Biphenyls (PCB)	CLP	6-in. sleeve	Cool, 4°C	14 days/40 days
Dioxins/Furans	EPA 8280	6-in. sleeve	Cool, 4°C	28 days/40 days
Total Petroleum Hydrocarbons-Purgeable	CA LUFT & EPA 8015A	6-in. sleeve	Cool, 4°C	14 days
Total Petroleum Hydrocarbons-Extractable	CA LUFT & EPA 8015A	6-in. sleeve	Cool, 4°C	14 days/40 days
<b>INORGANIC/PHYSICAL ANALYSES:</b>				
Metals	CLP	6-in. sleeve	Cool, 4°C	Mercury, 28 days; others, 6 months
Hexavalent Chromium	EPA 7196A	6-in. sleeve	Cool, 4°C	72 hours
pH	EPA 9045A	6-in. sleeve	Cool, 4°C	72 hours
Soil Bulk Density	ASTM D-2937	Shelby tube	NA <sup>e</sup>	NA
Soil Porosity	Calculated <sup>f</sup>	Shelby tube	NA	NA
Moisture Content	ASTM D-2216	6-in. sleeve	Cool, 4°C	2 weeks

TABLE 3-1

**INLAND AREA REMEDIAL INVESTIGATION  
SAMPLE CONTAINER, HOLDING TIMES, AND PRESERVATIVE  
REQUIREMENTS FOR SOIL SAMPLES  
(CONTINUED)**

Parameter	Method Number <sup>a</sup>	Sample Container	Preservative	Holding Time <sup>b</sup>
Grain Size Analysis (Hydrometer)	ASTM D-422	6-in. sleeve	NA	NA
Permeability	ASTM D-5-84	Shelby tube	NA	NA
Specific Gravity	ASTM D-854	6-in. sleeve	NA	NA

<sup>a</sup> Complete method references are presented in Section 8.0, Table 8-1  
<sup>b</sup> "x" days/"s" days refers to the maximum number of days from sampling to extraction/the maximum number of days from extraction to analysis  
<sup>c</sup> USEPA CLP Statement of Work for Inorganics Analyses, 1993, ILM03.0  
<sup>d</sup> USEPA CLP Statement of Work for Organic Analyses, 1993, OLM02.1  
<sup>e</sup> Auger will contain two 6-in. sleeves  
<sup>f</sup> Not applicable  
<sup>g</sup> Soil porosity is calculated using measured moisture content and soil density values  
ASTM - American Society for Testing and Materials  
CLP - Contract Laboratory Program  
LUFT - Leaking Underground Fuel Tank

TABLE 3-2

**INLAND AREA REMEDIAL INVESTIGATION  
SAMPLE CONTAINER, HOLDING TIMES, AND PRESERVATIVE  
REQUIREMENTS FOR WATER SAMPLES**

Parameter	Method Number <sup>a</sup>	Sample Container <sup>b</sup>	Sample Volume	Preservatives	Holding Time <sup>c</sup>
<b>ORGANIC ANALYSES:</b>					
Volatile Organic Compounds (VOC)	Modified CLP <sup>d</sup>	V	80 mL No headspace	HCl to pH <2 Cool, 4°C	14 days
Semivolatile Organic Compounds (SVOC)					
Organochlorine Pesticides and Polychlorinated Biphenyls (PCB)	CLP	G	2L	Cool, 4°C	7 days/40 days
Total Petroleum Hydrocarbons-Purgeable	CLP	G	2L	Cool, 4°C	7 days/40 days
	CA LUFT & EPA 8015A	V	80 mL No Headspace	HCl to pH <2 Cool, 4°C	14 days
Total Petroleum Hydrocarbons-Extractable	CA LUFT & EPA 8015A	G	2L	Cool, 4°C	7 days/40 days
<b>INORGANIC/PHYSICAL ANALYSES:</b>					
Metals	CLP	P	1L	Filter <sup>e</sup> , HNO <sub>3</sub> to pH <2	Mercury, 28 days; others, 6 months
Hexavalent Chromium	EPA 7196A	P	250 mL	Cool, 4°C	72 hours
Total Organic Carbon	EPA 415.1	G	125 mL	HCl to pH <2 Cool, 4°C	28 days
Total Suspended Solids	EPA 160.2	P	100 mL	Cool, 4°C	7 days
Nitrate/Nitrite	EPA 300.0	P	100 mL	Cool, 4°C	24 hours
General Minerals <sup>f</sup>		P	1L	Cool, 4°C	7 days (except metals, 6 months)
Alkalinity	EPA 310.1				
Foaming Agents/Surfactants (MBAS)	SM 5540C				
pH <sup>e</sup>	EPA 9040				
Sulfate	EPA 300.0				

TABLE 3-2

**INLAND AREA REMEDIAL INVESTIGATION  
SAMPLE CONTAINER, HOLDING TIMES, AND PRESERVATIVE  
REQUIREMENTS FOR WATER SAMPLES  
(CONTINUED)**

Parameter	Method Number <sup>a</sup>	Sample Container <sup>b</sup>	Sample Volume	Preservatives	Holding Time <sup>c</sup>
Fluoride	EPA 300.0				
Chloride	EPA 300.0				
Nitrate	EPA 300.0				
TDS	EPA 160.1				
Total Hardness	SM 2340C				
Specific Conductance <sup>d</sup>	EPA 120.1				
Metals (analyzed as described above -- Copper, Iron, Magnesium, Manganese, Sodium, Zinc, Calcium, Potassium)					
<p>CA LUFT - State of California Leaking Underground Fuel Tank Field Manual, 1989</p> <p><sup>a</sup> Complete method references are presented in Section 8.0, Table 8-2</p> <p><sup>b</sup> Container Types:      G = Amber glass with Teflon-lined lid, sized according to sample volume                                         P = Polyethylene container sized according to sample volume                                         V = VOC (VOA) vial with Teflon-lined septum, 40 mL size</p> <p><sup>c</sup> "x" days/"s" days refers to the maximum number of days from sampling to extraction/the maximum number of days from extraction to analysis</p> <p><sup>d</sup> USEPA CLP Statement of Work for Inorganic Analyses, 1993, ILM03.0            USEPA CLP Statement of Work for Organic Analyses, 1993, OLM02.1</p> <p><sup>e</sup> Filter using 5 micron filter</p> <p><sup>f</sup> General Minerals is a generic term for the listed analytes used to evaluate water quality</p> <p><sup>g</sup> Analysis performed in the field</p> <p>CLP - Contract Laboratory Program</p>					



TABLE 3-3

**INLAND AREA REMEDIAL INVESTIGATION  
ANALYTICAL METHODS FOR SOIL SAMPLES**

Parameter	Method Number	Extraction Technique <sup>a</sup>	Reference <sup>b</sup>	Analyte List <sup>c</sup>	Technique <sup>d</sup>
<b>ORGANIC ANALYSES:</b>					
Volatile Organic Compounds (VOC)	CLP	Purge and Trap (CLP/5030A)	OLM02.1	TCL + 10 TIC	GC/MS
Semivolatile Organic Compounds (SVOC) and Low Detection Limit SVOC	CLP	Sonication and GPC (CLP/3550A & 3640)	OLM02.1	TCL + 20 TIC	GC/MS
Organochlorine Pesticides and Polychlorinated Biphenyls (PCB)	CLP	Sonication and GPC (CLP/3550A & 3640)	OLM02.1	TCL	GC/ECD
Dioxins/Furans	EPA 8280	Sonication (3550A)	SW-846	Tetra-through Octa-CDDs and CDFs	GC/SIM
Total Petroleum Hydrocarbons-Purgeables	CA LUFT & EPA 8015A	Purge and Trap (5030A)	CA Luft & SW-846	Gasoline, BTEX	GC/FID, PID
Total Petroleum Hydrocarbons-Extractables	CA LUFT & EPA 8015A	Sonication (3550A)	CA Luft & SW-846	Diesel, Motor Oil	GC/FID
<b>INORGANIC/PHYSICAL ANALYSES:</b>					
Metals	CLP	Acid Digestion (CLP/3050A)	ILM03.0	TAL	ICP & AA
Hexavalent Chromium	EPA 7196A	Distilled Water Extraction	SW-846		Colorimetric
pH	EPA 9045A	NA	SW-846		pH Meter
Grain Size Analysis (Hydrometer)	ASTM D-422	NA	ASTM		
Soil Porosity	Calculate	NA	SW-846		
Permeability	ASTM D-5084	NA	ASTM		
Soil Bulk Density	ASTM D-2937	NA	ASTM		
Specific Gravity	ASTM D-854	NA	ASTM		
Moisture Content	ASTM D-2216	NA	ASTM		

<sup>a</sup> The extraction procedures for CLP analyses are specified in the CLP statement of work, but are based on the listed EPA method.  
<sup>b</sup> GPC: gel permeation chromatography extract cleanup

TABLE 3-3

**INLAND AREA REMEDIAL INVESTIGATION  
ANALYTICAL METHODS FOR SOIL SAMPLES  
(CONTINUED)**

b	CLP:	contract laboratory program
		USEPA CLP Statement of Work for Organic Analyses, OLM02.1
		USEPA CLP Statement of Work for Inorganic Analyses, ILM03.0
	SW-846:	EPA Test Methods for Evaluating Solid Waste, 1986 with updates through 1990
c	CA LUFT:	State of California Leaking Underground Fuel Tank Field Manual, 1989
	ASTM:	American Society for Testing and Materials
	TCL:	target compound list
	TAL:	target analyte list
d	TIC:	tentatively identified compounds
	BTEX:	benzene, toluene, ethylbenzene, xylenes
	CDD:	chlorodibenzo-p-dioxin
	CDF:	chlorodibenzofuran
	GC:	gas chromatography
	MS:	mass spectrometry
	ECD:	electron capture detector
	SIM:	selective ion monitoring
	FID:	flame ionization detector
	PID:	photoionization detector
	ICP:	inductively coupled plasma emission spectroscopy
	AA:	atomic absorption spectroscopy

TABLE 3-4

**INLAND AREA REMEDIAL INVESTIGATION  
ANALYTICAL METHODS FOR WATER SAMPLES**

Parameter	Method Number	Extraction Technique <sup>a</sup>	Reference <sup>b</sup>	Analyte List <sup>c</sup>	Technique <sup>d</sup>
<b>ORGANIC ANALYSES:</b>					
Volatile Organic Compounds (VOC)	Modified CLP	25ml Purge and Trap (Modified 5030A)	OLM02.1	TCL + 10 TIC	GC/MS
Semivolatile Organic Compounds (SVOC)	CLP	Continuous Liquid-Liquid Extraction and GPC (CLP/3520A, 3640)	OLM02.1	TCL + 20 TIC	GC/MS
Organochlorine Pesticides and Polychlorinated Biphenyls (PCB)	CLP	Continuous Liquid-Liquid Extraction and GPC (CLP/3520A & 3640)	OLM02.1	TCL	GC/ECD
Total Petroleum Hydrocarbons-Purgeables	CA LUFT & EPA 8015A	Purge and Trap (5030A)	CA Luft & SW-846	Gasoline, BTEX	GC/FID, PID
Total Petroleum Hydrocarbons-Extractables	CA LUFT & EPA 8015A	Separatory Funnel (3510A)	CA Luft & SW-846	Diesel, Motor Oil	GC/FID
<b>INORGANIC/PHYSICAL ANALYSES:</b>					
Metals	CLP	Acid Digestion (CLP/3010A)	ILM03.0	TAL	ICP & AA
Hexavalent Chromium	EPA 7196A	NA	SW-846		Colorimetric
Total Organic Carbon	EPA 415.1	NA	EPA 1983		Combustion/Oxidation
Nitrate/Nitrite	EPA 300.0	NA	EPA 1983		Colorimetric
Total Suspended Solids	EPA 160.2	NA	EPA 1983		Gravimetric
pH	EPA 9040	NA	SW-846		pH Meter
<b>General Minerals<sup>e</sup>:</b>					
Alkalinity	EPA 310.1	NA	EPA 1983		Titration
Foaming Agents/Surfactants (MBAS)	SM 5540C	NA	APHA 1992		Colorimetric
pH	EPA 9040	NA	SW-846		pH Meter
Sulfate, Fluoride, and Chloride	EPA 300.0	NA	EPA 1984		Ion Chromatography
Nitrate	EPA 300.0	NA	EPA 1983		Colorimetric
TDS	EPA 160.1	NA	EPA 1983		Gravimetric
Total Hardness	SM 2340C	NA	APHA 1992		Titration
Specific Conductance <sup>f</sup>	EPA 120.1	NA	EPA 1983		Conductivity Meter

TABLE 3-4

**INLAND AREA REMEDIAL INVESTIGATION  
ANALYTICAL METHODS FOR WATER SAMPLES  
(CONTINUED)**

Parameter	Method Number	Extraction Technique <sup>a</sup>	Reference <sup>b</sup>	Analyte List <sup>c</sup>	Technique <sup>d</sup>
Metals (Copper, Iron, Magnesium, Manganese, Sodium, Zinc, Calcium, Potassium)	CLP	Acid Digestion (CLP/3010A)	ILM03.0		ICP
<sup>a</sup> The extraction procedures for CLP analyses are specified in the CLP statement of work, but are based on the listed EPA method.					
GPC:	gel permeation chromatography extract cleanup				
<sup>b</sup> CLP:	contract laboratory program				
	USEPA CLP Statement of Work for Organic Analyses, OLM02.1				
	USEPA CLP Statement of Work for Inorganic Analyses, ILM03.0				
SW-846:	EPA Test Methods for Evaluating Solid Waste, 1986 with updates through 1990				
EPA:	Methods for Chemical Analysis of Water and Wastes, March 1983				
APHA:	Standard Methods for the Examination of Water and Wastewater, 1992				
CA LUFT:	State of California Leaking Underground Fuel Tank Field Manual, 1989				
ASTM:	American Society for Testing and Materials				
<sup>c</sup> TCL:	target compound list				
TAL:	target analyte list				
TIC:	tentatively identified compounds				
BTEX:	benzene, toluene, ethylbenzene, xylenes				
CDD:	chlorodibenzo-p-dioxin				
CDF:	chlorodibenzofuran				
GC:	gas chromatography				
MS:	mass spectrometry				
ECD:	electron capture detector				
SIM:	selective ion monitoring				
FID:	flame ionization detector				
PID:	photoionization detector				
ICP:	inductively coupled plasma emission spectroscopy				
AA:	atomic absorption spectroscopy				
<sup>e</sup> General Minerals	is a generic term for the listed analytes that are used to evaluate water quality.				
<sup>f</sup> Specific conductance	is measured in the field.				
APHA - American Public Health Association					

#### 4.0 PRELIMINARY IDENTIFICATION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Section 121(d) of CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA), states that remedial actions must attain or exceed ARARs. ARARs may include regulations, standards, criteria, or limitations promulgated under federal or state laws. An ARAR may be either "applicable," or "relevant and appropriate," but not both. The NCP (40 CFR Part 300) defines "applicable," and "relevant and appropriate," as follows:

- "Applicable requirements means those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be applicable."
- "Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting law that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified by a state in a timely manner and that are more stringent than federal requirements may be relevant and appropriate."

The preliminary identification of ARARs involves considering a number of site-specific factors including potential remedial actions, compounds at the site, the physical characteristics of the site, and the site location. A requirement is applicable if it directly and fully addresses or regulates the hazardous substance, pollutant, contaminant, action being taken, or other circumstances at the site.

If a requirement is not applicable, the next step is to consider whether the requirement is relevant and appropriate. The basic considerations when determining whether a requirement is relevant and appropriate include evaluating whether the requirement (1) regulates or addresses problems sufficiently similar to those encountered at the CERCLA site (that is, relevance) and (2) is appropriate to the

circumstances of the release, such that its use is well suited to the particular site. A requirement may be relevant, but not appropriate, given site-specific conditions. Moreover, only part of a requirement may be considered relevant or appropriate in a given situation.

Only substantive provisions of laws and regulations are considered ARARs. Section 121(e)(1) of CERCLA states that A[n]o...permit shall be required for the portion of any removal or remedial action conducted entirely onsite...≡ Permits are considered procedural or administrative requirements.

Provisions of generally relevant federal and state statutes and regulations that are procedural or non-environmental, including permit requirements, are not ARARs.

Further, ARARs only apply to hazardous substances, pollutants, or contaminants that will remain on site. Off-site actions, such as discharges to a publicly owned treatment works (POTW) and treatment of waste residuals at an off-site hazardous waste treatment, storage, or disposal facility, must meet all applicable requirements. For this reason, such requirements are not identified as ARARs.

ARARs may be waived under certain conditions as set forth in Section 121(d) (4) of CERCLA as amended by SARA. These circumstances are as follows:

- The remedial action selected is only part of a total remedial action that will attain the ARAR when completed.
- Compliance with the ARAR will result in greater risk to human health and the environment.
- Compliance with the ARAR is technically impractical from an engineering perspective.
- The remedial action selected will attain a standard of performance equivalent to the ARAR through use of another method or approach.
- With respect to a state ARAR, the state has not consistently applied or demonstrated the intention to consistently apply the standard, requirement, criteria, or limitation in similar circumstances for other remedial actions within the state.

Several of these waivers may be relevant to the Concord Inland Area sites or to specific remedial alternatives and will require further technical evaluation. As the investigation moves into the FS and design phases, the Navy will evaluate whether it is appropriate to waive an ARAR.

In addition to ARARs, the NCP provides that agency advisories, criteria, or guidance may, as appropriate be considered (Ato be considered or ATBCs) for a particular release. The TBC category consists of advisories, criteria, or guidance that were developed by EPA and other federal agencies, or states that may be useful in developing CERCLA remedies, (40 CFR Part 300.400[g][3]). As explained in the preamble to the NCP, "TBCs should not be required as cleanup standards because they are, by definition, generally neither promulgated nor enforceable so they do not have the same status under CERCLA as do ARARs. TBCs may, however be very useful in helping to determine what is protective at a site, or how to carry out certain actions or requirements" (55 Fed. Reg. 8745).

As the lead agency under CERCLA at WPNSTA Concord, the Navy is responsible for identifying federal ARARs. The state is responsible for identifying and advising the Navy of potential state ARARs. The Navy formally requested ARARs from the state for all Inland Area sites in August 1993. Responses were received.

ARARs identified for remedial actions are based on anticipated chemicals present, the location of the site, and possible remedial actions for the site. This report presents only the chemical- and location-specific federal ARARs that may be applicable to Inland Area sites. Table 4-1 presents the specific ARARs applicable to the Inland area sites. Action-specific ARARs will be discussed in the FS, after remedial alternatives have been identified. As the RI/FS process continues, the ARARs will continue to be refined and adjusted. A final determination of ARARs will be identified prior to completion of final decision documents for the Inland Area sites.

#### **4.1 CHEMICAL-SPECIFIC ARARs**

Chemical-specific ARARs are health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical cleanup values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment. If a chemical has more than one ARAR, the most stringent will be identified as an ARAR for any remedial action. The two media of concern are soil and groundwater at the Inland Area sites; surface water is not present at these sites and is not a concern.

#### **4.1.1 SOIL**

Chemical-specific ARARs for soil include the PCB Spill Cleanup Policy and the hazardous waste identification criteria. The PCB policy has not been promulgated, therefore it will be a TBC criterion. The hazardous waste identification regulations are implemented by the California Department of Toxic Substances Control. These regulations provide criteria for determining if excavated soil must be managed as a hazardous waste.

#### **4.1.2 Groundwater**

The potential chemical-specific ARARs have been identified in Table 4-1 for surrounding groundwater at the Inland area sites. Table 4-1 screens the specific requirements under the pertinent statutes and identifies the potential groundwater chemical-specific ARARs for the Inland area sites.

Groundwater protection standards are promulgated under the federal Clean Water Act. For the Inland Area sites, water quality objectives will be based on state requirements, because they are developed in conjunction with the Clean Water Act. The San Francisco Bay Basin Water Quality Control Plan (RWQCB, 1996) contains water quality objectives for specified beneficial uses.

The Safe Drinking Water Act (SDWA) establishes primary and secondary maximum contaminant levels (MCL) and maximum contaminant level goals (MCLG) for drinking water. SDWA MCLs and nonzero MCLGs are not applicable but may be relevant and appropriate for establishing cleanup levels of groundwater that is or could be a source of drinking water. Groundwater in the Inland Area is not presently used as drinking water but it does meet the State Water Resources Control Board (SWRCB) criteria for determining suitability for drinking water in accordance with SWRCB Resolution No. 88-63. Therefore, MCLs and nonzero MCLGs are relevant and appropriate for groundwater in the Inland Area.

#### **4.2 LOCATION-SPECIFIC ARARS**

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities due to the characteristics of the site or its immediate environment. For example, location of the site or proposed remedial action in a flood plain, wetland, historic place, or sensitive



ecosystem may trigger location-specific ARARs. Potential location-specific ARARs for the Inland area sites are screened in Table 4-1.

#### **4.3 ACTION-SPECIFIC ARARS**

Action-specific ARARs are technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes. These requirements are triggered by the particular remedial activities selected. Action-specific ARARs do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be achieved. Therefore, since action-specific ARARs depend on the action selected, they will be evaluated after technologies have been screened in the FS.

**TABLE 4-1**  
**PRELIMINARY IDENTIFICATION OF FEDERAL**  
**APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS**  
**INLAND AREA SITES, NAVAL WEAPONS STATION CONCORD**

Statutory Citation	Regulatory Citation	Medium	Description	Preliminary ARARS Determination	Comments
<b>Chemical-Specific Requirements</b>					
Safe Drinking Water Act (42 U.S.C. 9300f et seq.)	40 CFR Part 141: National Primary Drinking Water Regulations; 40 CFR Part 143: National Secondary Drinking Water Regulations	Water	Establishes maximum contaminant levels (MCL), maximum contaminant level goals (MCLG), or secondary maximum contamination levels (SMCL) for drinking water.	Relevant and Appropriate	MCLs, nonzero MCLGs, and/or SMCLs are only applicable to drinking water supplies. MCLs and nonzero MCLGs are relevant and appropriate cleanup levels for groundwater that is or could be used for drinking. There are no surface water drinking supplies in the Inland area, WPNSTA Concord. Inland area groundwater is not currently used for drinking but is a potential drinking water source in accordance with SWRCB Resolution No. 88-63. Therefore, MCLs and nonzero MCLGs are considered relevant and appropriate to the Inland Area groundwater.
Clean Water Act (33 U.S.C. 91251 et seq.)	40 CFR Part 131 Subpart D: Federally Promulgated Water Quality Standards	Water 131.136	Establishes water quality criteria for some areas of California	Applicable	WPNSTA Concord Inland Area sites covered in the geographical area
Clean Water Act (33 U.S.C. 91251 et seq.)	San Francisco Bay Basin Water Quality Control Plan	Water	Establishes water quality objectives for specified beneficial uses	Relevant and Appropriate	The U.S. Environmental Protection Agency authorizes states to implement water quality standards under the Clean Water Act (Section 303(c))
Toxic Substances Control Act (15 U.S.C. 92601 et seq.)	40 CFR 9761.125: PCB Spill Cleanup Policy	Water and Soil	Establishes storage, disposal, and spill clean-up requirements for polychlorinated biphenyls (PCBs)	To Be Considered	The spill cleanup policy contains cleanup levels for PCBs in water and soil, but it has not been promulgated by U.S. EPA.
Hazardous Waste Identification Regulation	CCR 966260.200	Soil	Provide criteria for determining if excavated soil must be managed as a hazardous waste.	Relevant and Appropriate	Applicability will depend on the remedial action selected for each site.
<b>Location-Specific Requirements</b>					
Clean Water Act (33 U.S.C. 91251 et seq.)	Clean Water Act, Section 404; 40 CFR Part 230, 33 CFR Parts 320-330	Water and Soil	Establishes guidelines for discharge of dredged or fill material.	To Be Determined	Applicability will depend on the remedial action selected for each site
Endangered Species Act (16 U.S.C. 91531 et seq.)	50 CFR Part 17: Endangered and Threatened Wildlife and Plants	Water and Soil	Requires federal agencies to ensure that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any threatened/endangered species, or destroy or adversely modify critical habitat.	Applicable to Inland Area sites 13, 17	Sites 13, 17 Endangered species habitat - American peregrine falcon, Golden Eagle, White-tailed kite, Bald eagle, California tiger salamander, California redlegged frog
Executive Order 11990 - Wetlands	40 CFR 6, Appendix 6 (EPA Policy re: Executive Order 11990)	Water and Soil	Controls adverse effects, minimizes potential harm, and preserves and enhances wetlands, to the extent possible.	Applicable to Inland Area site 17 Seal Creek	Impacts to wetlands will depend on the remedial action selected for Site 17
Migratory Bird Treaty (16 U.S.C. 9703 et seq.)		Water and Soil	Protects certain migratory birds and their nests and eggs.	To Be Determined	Migratory birds are present throughout WPNSTA Concord. Applicability will depend on the remedial action selected for each site.
Migratory Bird Conservation Act (16 U.S.C. 9715 et seq.)		Water and Soil	Protects migratory birds by limiting the purchase, rental, or acquisition of areas of land or water that may be sanctuaries for migratory birds.	Relevant and Appropriate	Migratory birds are present throughout WPNSTA Concord.

## **5.0 RESULTS OF THE RI/FS AT THE BURN AREA (SITE 13)**

This section presents the results of the RI/FS at the Burn Area (Site 13). The Burn Area was used from the late 1940s until approximately 1974 to dispose of live ordnance by burning. The objective of the RI at the Burn Area is to evaluate the nature and extent of chemicals present in soil and groundwater as a result of past ordnance disposal activities.

### **5.1 PHYSICAL DESCRIPTION AND PAST OPERATIONS**

The Burn Area is located in the western portion of the Inland Area of NWS Concord between the Landing Field and Kinne Blvd. (Figure 1-3), and within the area bounded on the west by Wake Way, and on the southeast by Tarawa Way (Figure 5-1). The Contra Costa Canal runs parallel to Wake Way along the west side of the road. Portions of the approximately 1,100- by 1,400-foot area were used for the destruction of live ordnance. Most of the ordnance was reportedly destroyed by burning in large trenches and gullies. The IAS indicated that the trenches in which burning activities were conducted were excavated specifically for this purpose (E&E 1983). Additionally, some burning occurred in gullies formed by natural erosion processes. A representative of the PWD at NWS Concord indicated that some of the trenches were created to construct additional railcar revetments; however, this construction was canceled after their initial excavation (Evans 1992).

As shown in Figure 5-1, the topography of the northeast part of the site is somewhat steep, slopes to the west/southwest, and is incised by anthropogenic trenches and naturally occurring gullies. Structurally, the hills are formed by a gentle, west-northwest-trending anticline that mimics the trend of the Clayton Fault (occurring approximately 7,000 feet to the northwest) (Dibblee 1981). The topography flattens a few hundred feet west of Wake Way in the southwest part of the site, representing the present-day alluvial floodplain.

Some of the ordnance reportedly burned at the site included flares, smoke chemicals, Thermite generators, small arms ammunition, powder, and loose material cleaned from ammunition ships (E&E 1983). Thousands of Mark (MK) 1 and MK 13 flares were reportedly burned or buried in the burn pit. The powder from 40,000 5-inch rockets and several thousand photoflash cartridges were reportedly

burned. In 1947, a "large quantity of smoke chemicals" (reportedly sulfur trioxide and chlorosulfonic acid) were also reportedly disposed at the site (E&E 1983). An estimated 500,000 pounds of explosives (both black and smokeless powder) were reportedly destroyed at this site from 1967 to 1969.

Quantitative estimates for other time periods are not available. Additionally, the area was used briefly as a fire-fighting training area during, where napalm and fuel oil were ignited and extinguished by firefighters (E&E 1983). Residual material from ordnance burning was reportedly removed and disposed of off site; however, some scattered surface ordnance debris is still evident. NWS Concord explosive ordnance disposal (EOD) personnel also stated that target practice with 50-caliber machine guns had been conducted at the site in the recent past (Diehl 1992).

## **5.2 PHYSICAL CHARACTERISTICS**

The following section presents the physical setting, geology, hydrogeology, and ecology for Site 13.

### **5.2.1 Physical Setting**

The Burn Area covers an approximate 1,100- by 1,400-foot area situated on a southwestern-facing slope in the western portion of NWS Concord (Figure 5-1). The upper portions of the site are fairly steep with an approximate 15 percent grade. The steeper areas of the site are incised by natural gullies, revetments, and trenches that are wholly manmade or are modified gullies. These gullies may be up to 900 feet in length across the site. The lower portions of the site have a gentle grade. At the western edge of the site is Wake Way. Running parallel to Wake Way approximately 200 feet to the west is the Contra Costa Canal. Surface water flowing from the site crosses Wake Way through culverts beneath the road and pools behind the eastern levee of the canal. During the rainy season, pooled surface water may rise high enough to enter the canal through culverts. From this part of NWS Concord, the Contra Costa Canal continues south toward the cities of Concord and Walnut Creek.

### **5.2.2 Geology**

Site 13 is located in the western part of NWS Concord, just north of Willow Pass Road and on the southwestern side of a range of low hills. Geologic mapping by Dibblee (1980c, 1981) shows the site to be underlain by older alluvium that is slightly deformed.

The logs of soil borings, included in Appendix B, and trench excavations, included in Appendix C, show that Site 13 is underlain by alluvium that consists of interbedded clay, silt, sand, and gravel. The transects of three cross sections constructed from the boring logs are shown on Figure 5-2. These cross sections (Figures 5-3, 5-4, and 5-5) show that the alluvium can be subdivided into two units beneath Site 13. Sediments above an elevation of 80 to 90 feet are composed primarily of clay and silt with discontinuous interbeds of sand and gravel. In contrast, alluvium below a elevation of 80 to 90 feet is composed primarily of sand and gravel. Both of these units are part of the local Quaternary young alluvium depicted on Figure 2-4.

### **5.2.3 Hydrogeology**

Hydrogeologic conditions beneath Site 13 were evaluated using information from soil borings and wells installed during the SI and RI in the northern portion of the site, and from logs from wells installed for a UNOCAL pipelines investigation in the southern part of the site (GTI 1991).

The deep sand and gravel unit was observed in all of the deeper wells in the northern portion of Site 13 (Figures 5-2 and 5-3), suggesting that it is laterally continuous beneath the site. Available boring logs show the top of this unit declines in elevation toward the northwest. Depending on the surface elevation, groundwater was typically encountered at depths ranging from approximately 35 to 118 feet, and rose about 15 to 19 feet in completed monitoring wells, indicating that groundwater exists in the sand and gravel unit under confined conditions.

Wells BUA-MW-011 and BUA-MW-012 are clearly screened in the deep sand/gravel unit (Figures 5-3, 5-4, and 5-5). Well BUA-MW-010 is screened at a slightly higher elevation in an approximately 5-foot-thick sand bed at an elevation of about 80 ft msl (Figure 5-3 and 5-5). Groundwater was first encountered while drilling this well at a higher elevation than at nearby wells in the northern portion of the site. However, due to the similarity in static water conditions measured across the site, the shallower sand unit across which well BUA-MW-010 is screened is likely in hydraulic connection with the deeper sand/gravel layer in which wells BUA-MW-011 and BUA-MW-012 are screened.

Groundwater elevation data were collected during the groundwater sampling on June 9, 13, and 14, 1995; June 28, 1995; and September 11, 1995. Groundwater elevation measurements for the June and

September 1995 sampling and gauging events are included in Appendix E. Data from the June 14, 1995 groundwater measurements of well BUA-MW-011 are questionable because the water levels recorded on field sampling forms are exactly the same during the approximately 1 1/4 hours during which the well was being purged. The depth to groundwater in this well was subsequently measured at 101.38 feet on June 28, 1995 and 101.54 feet on September 11, 1995. The approximately 8-foot difference between the first groundwater elevation measurement and the later two, and the lack of depth fluctuations during purging of the well, suggests that an error was made in the June 14, 1995 measurement. As a result, the data from June 14, 1995 were not used to construct groundwater contours at Site 13.

Vertical permeability of the water-bearing soils in the northern portion of the site was assessed in three wells using geotechnical samples collected during the RI. The vertical permeability calculated from the sample from well BUA-MW-010 is  $1.00\text{E-}07$  centimeters per second (cm/sec). Vertical permeabilities from samples collected from wells BUA-MW-011 and BUA-MW-012 were calculated to be  $1.50\text{E-}01$  cm/sec and  $1.00\text{E-}07$  cm/sec, respectively. The geotechnical laboratory reports are presented in Appendix D. A summary of geotechnical results for Site 13 is presented in Table 5-1.

Hydrogeologic characteristics of water-bearing sands are provided by slug test data from well BUA-02-MWA. This well, shown on cross section C-C' on Figure 5-3, is screened in sand at an elevation of between approximately 90 and 100 feet msl. Hydraulic conductivity was estimated to be 58 feet/day.

Groundwater contours from June 28, 1995 are shown on Figure 5-6. Groundwater contours from data obtained on September 11, 1995 are shown on Figure 5-7. Groundwater elevations in the northern portion of the site ranged from approximately 100 to 103 feet msl. The groundwater flow is toward the west-southwest, with an average gradient of about 0.0022 ft/ft. Groundwater levels in this vicinity dropped between about 0.2 feet to 1.9 feet between the June and September 1995 gauging events.

Groundwater in the UNOCAL wells located in the southern part of Site 13 was first encountered in clayey soils at depths between 10 to 14 feet (GTI 1991), above the laterally extensive sand/gravel unit. Each of these wells is screened in portions of the shallower clayey soils, but each extends into deeper sand and gravel that may be hydraulically connected to the sand/gravel unit farther north (Figure 5-3). The report containing data on the installation of the UNOCAL wells (GTI 1991) does not indicate

whether groundwater levels rose during or shortly after installation of these wells, so it is not clear if groundwater in the southern portion of Site 13 exists under confined or unconfined conditions.

In June 1995, water levels in the UNOCAL wells ranged between approximately 7 to 9 feet bgs, corresponding to elevations of 94 to 97 feet above msl. In September 1995 water levels ranged from about 10 to 13 feet bgs, corresponding to elevations of 91 to 94 feet above msl. The groundwater elevation in this vicinity dropped an average of 3.5 feet between the two gauging events, displaying the greatest seasonal fluctuation observed among the Inland Area sites monitored during RI activities.

Due to the differences in groundwater conditions observed between the northern and southern portions of Site 13, groundwater contours displayed on Figures 5-4 and 5-6 were drawn separately, as the relationship between the two areas is not presently well defined.

Groundwater flow direction as derived from groundwater elevation data obtained from the UNOCAL wells in June and September 1995 show groundwater to be moving in a generally westerly direction (Figures 5-6 and 5-7) with a gradient of 0.0096 ft/ft.

#### **5.2.4 Ecological Characterization**

The following sections present the habitats, vegetation, fauna, and receptors for the Burn Area (Site 13). The habitat and receptor characterization consisted of the following study elements:

- Reviewing available literature pertaining to the site, including any past site surveys
- Describing the nature and composition of the plant and animal communities
- Evaluating the potential habitat value of each terrestrial community
- Surveying wildlife species and habitats
- Compiling basic information about federal or state rare, threatened, or endangered species that may be present

The relatively small size of the Burn Area, the close proximity of various habitat types, and the small size of habitat patches do not allow for defined boundaries to clearly distinguish between species residing on site or off site. The habitat observed at the Burn Area is described below.

#### **5.2.4.1 Habitat Types and Vegetation**

Jones & Stokes (1982) conducted a natural resources survey of the Inland Area. The report classifies habitat types in terms of vegetation structure, composition, and other features. Fifty percent of the NWS Concord mainland is composed of valley and foothill grasslands characteristic of Site 13. Soils are characterized as hard-packed, dry, and relatively infertile. Soil invertebrates and plant diversity are both relatively low. Nonnative grasses and forbs such as thistles and filaree dominate the landscape. Most of the grasslands are grazed by cattle, and steep slopes and high ridges comprise the majority of the least disturbed grassland areas. Although highly disturbed in the past by agriculture and construction activities, vegetation structure and composition are similar to that of disturbed valley and foothill grasslands.

#### **5.2.4.2 Grassland Fauna**

Grassland habitat at the Burn Area supports insects and terrestrial vertebrates including reptiles, amphibians, birds, and small and large mammals. Grazed and ungrazed upland areas are host to an abundant population of deer mice, house mice, and the California vole. Ungrazed areas support small populations of western harvest mice. Trapping success rates at Inland Areas sites indicated that small mammal populations in the grassland interior of NWS Concord are low (Jones and Stokes 1982). According to the survey results conducted by the UCB in 1994, predatory mammals such as the red fox and coyote are prevalent in the grasslands of NWS Concord and may use the Burn Area as a habitat to hunt for prey. The great-horned owl was observed during consecutive nocturnal surveys conducted in the Inland Area of NWS Concord, and several predatory raptors were observed at the Burn Area, including the sharp-shinned hawk, red-tailed hawk, and merlin.



#### 5.2.4.3 Special Status Receptors

Special status species are plants or animals legally protected under state and federal endangered species acts or other regulations. No special status species have been observed at the Burn Area, but a literature review was conducted to identify potentially occurring special status species at the Burn Area. The data was compiled from the California Natural Diversity Data Base (1994) records for the Vine Hill, Honker Bay, Benicia, Briones Valley, Walnut Creek, Clayton, Cordelia, Fairfield South and Denverton quadrangles, the California Native Plant Society (CNPS) Inventory (Smith and Berg 1988), and the Wildlife Survey of Concord Naval Weapons Station (Western Division, Naval Facilities Engineering Command 1994). Based on literature review, species that could be present in the grassland habitat of the Burn Area include the following:

- American peregrine falcon, *Falco peregrinus anatum* (federal and state endangered)
- Golden eagle, *Aquila chrysaetos* (state species of special concern)
- White-tailed kite, *Elanus leucurus* (Contra Costa County unique wildlife)
- Bald eagle, *Haliaetus leucocephalus* (federal and state endangered)
- Grasshopper sparrow, *Ammodramus savannarum* (Contra Costa County unique wildlife)
- California legless lizard, *Anniella pulchra pulchra* (state species of special concern)

As part of the RI, a rare, threatened, and endangered plant survey was also conducted at the Burn Area. Upon completion, survey results indicated no protected plant species occurred on site. The UCB wildlife survey conducted in 1994 (Western Division, Naval Facilities Engineering Command 1994) also states that no protected plant species were observed in the grasslands of NWS Concord.

### 5.3 RESULTS OF PREVIOUS INVESTIGATIONS

**Initial Assessment Study.** The IAS recommended further investigation of the Burn Area because residue and by-products may constitute a threat to terrestrial ecosystems (E&E 1983). This area had been leased for grazing for a number of years. Nine cows grazing near Site 13 died in 1980, reportedly of nitrate poisoning; however, prior land use at the site by the Navy was not found to be the cause of the cattle deaths (E&E 1983).

**Confirmation Study (CS).** The CS was the first invasive investigation at Site 13. It consisted of a cursory sampling program of 25 surface or shallow (0- to 6-inch and 12- to 18-inch) soil samples and was conducted by Anderson Geotechnical Consultants, Inc. (AG) and Brown and Caldwell Consulting Engineers (B&C). A geometric grid was established to assess general site conditions but may have missed specific waste point sources. Samples were analyzed for arsenic, barium, copper, and lead on all samples and for extractable organics (one sample only). These metals were detected at the site with maximum concentrations of arsenic at 39 milligrams per kilogram (mg/kg), barium at 420 mg/kg, copper at 51 mg/kg, and lead at 220 mg/kg (AG and B&C 1984). The CS report recommended no further investigation based on the data obtained from the sampling program.

**Other Previous Investigations.** Southeast of the site, across Tarawa Way (Figure 5-1), a UNOCAL petroleum pipeline was broken by UNOCAL while installing a cathodic protection well and an estimated two to three barrels of San Joaquin crude oil were released to the subsurface environment (Groundwater Technology, Inc. [GTI] 1991). As part of the investigation and subsequent soil cleanup, UNOCAL installed and sampled five shallow groundwater monitoring wells, UC-01 through UC-05 (well UC-03 was later abandoned during soil remediation). During the soil excavation, eight pieces of ordnance were encountered. The ordnance consisted of three live "50-millimeter" (probably 50-caliber) machine gun shells and five "dummy" bombs. All of the ordnance was found at a depth of 1 to 2 feet bgs within an area of approximately 400 square feet, located north of the UNOCAL pipeline between the fence line on the west side of the canal and the frontage road (Figure 5-1) (GTI 1991). The ordnance was removed during soil cleanup.

Two adjacent piezometers are located along the northeast side of the site (Figure 5-1). According to IT Corp. (1989), one of the borings was terminated at 110 feet bgs. The southern piezometer is approximately 50 feet deep and does not encounter groundwater. The northern piezometer is at least 100 feet deep and groundwater was encountered at approximately 52 feet bgs.

**Site Investigation.** After review of the data generated during previous investigations, the Navy determined that further investigations were warranted. To characterize the site, a program of surface geophysical surveys, soil sampling, and groundwater well installation and sampling was executed (PRC/JMM 1992a, 1992b). The chemicals of concern during the SI were metals, petroleum-related hydrocarbons, explosive chemicals, and nitrate/nitrite.

The SI activities at Site 13 included: (1) a surface geophysical survey of unexploded ordnance (UXO), (2) excavating and sampling 14 shallow (2 feet bgs) trenches, (3) drilling and sampling five deep (30 to 100 feet bgs) soil borings, and (4) installing and sampling one groundwater monitoring well. As discussed below, only one groundwater monitoring well was installed due to unexpected hydrogeologic conditions (PRC/Montgomery Watson 1993a). SI sampling locations are shown on Figure 5-8.

The surface UXO geophysical survey and surface inspection was conducted prior to excavating the trenches to identify potential UXO. The UXO geophysical survey and visual inspection were performed within the trenches, depressions, and gullies to identify debris remaining from ordnance burning.

During the field investigation, no live ordnance was encountered; however, spent ordnance, ordnance fragments, ordnance-related fragments, slag, and unidentifiable metallic debris were present in the top 1 foot of soil (PRC/Montgomery Watson 1993a). Spent ordnance included 50-caliber and 40-millimeter shell casings, spent flare cartridges, and four 14-inch-diameter projectiles. Ordnance fragments included flash tubes, remains of ejection seat charges, and pieces of smoke grenades. The most common ordnance-related fragments encountered were small bundles of metallic strapping material. Pieces of aluminum slag were also found in some of the trenches. Much of the metallic material encountered was unidentifiable. The most commonly observed feature in the trenches was blackened soil, presumably due to burning activities. Where present, the blackened soil was collected for chemical analysis.

In two of the trench excavations (BUA-09-TP and BUA-11-TP), possible flare residue was observed and sampled. In some cases, no visible disturbance or discoloration was observed and soil samples were collected at 0.5 and 2 feet bgs.

In trench BUA-13-TP (Figure 5-8), a 3- to 5-inch layer of a semisolid, dark honey-colored material was encountered during trenching. The visible surface extent of the material was approximately 70 square feet. When fresh surfaces were disturbed, volatile chemicals (as detected by a PID) were released and produced a maximum PID reading of 135 parts per million (ppm). The Navy EOD personnel suggested that the material was remnant napalm thickener, based on its appearance and the presence of "flame bombs" fragments near the material (PRC/Montgomery Watson 1993a). A sample of the material and a soil sample from directly beneath the material were collected. Soil samples collected from the trench excavation phase of the investigation were analyzed for explosives, metals, and nitrate/nitrite. Soil

samples from areas of possible napalm ignition were also analyzed for total petroleum hydrocarbons (TPH) and benzene, toluene, ethylbenzene, and xylene (BTEX) (Figure 5-9). TPH as diesel (TPH-D), xylene, and toluene were detected in these soil samples. The suspected napalm thickener was analyzed by the Toxicity Characteristic Leaching Procedure (TCLP) method for VOCs (Method 1311) to evaluate waste disposal options, and BTEX constituents were detected. The presence of these hydrocarbons indicates that the suspected napalm thickener is in fact napalm, and will be referred to as napalm.

Explosive chemicals were not detected in any of the 47 surface or near-surface soil samples collected at the site. Petroleum hydrocarbons, quantified as TPH-D, were detected at concentrations of 139,000 mg/kg in the soil sample collected just beneath the napalm in trench BUA-13-TP. Ortho-xylene and toluene were also detected in this soil sample at concentrations of 1.55 micrograms per kilogram ( $\mu\text{g/kg}$ ) and 1.30  $\mu\text{g/kg}$ , respectively. The TCLP-VOC leachate of the napalm contained BTEX constituents at concentrations of 19,000 (benzene), 510 (toluene), 3,200 (ethylbenzene), and 3,900 (xylene) micrograms per liter ( $\mu\text{g/L}$ ). Methylene chloride was also detected in the leachate, but may have been a laboratory artifact. TPH-D and toluene were also detected at concentrations up to 6.7 mg/kg and 2.33  $\mu\text{g/kg}$ , respectively, in soil samples collected from trenches BUA-03-TP, BUA-04-TP, and BUA-10-TP, where napalm and fuel oil were reportedly burned (PRC/Montgomery Watson 1993a).

Nitrates/nitrites were detected in most of the soil samples at concentrations up to 100 mg/kg; however, they were detected in soil samples collected from trenches BUA-04-TP and BUA-06-TP at concentrations of 405 mg/kg and 888 mg/kg, respectively. The 0.5-foot-bgs sample collected from trench BUA-14-TP contained nitrate/nitrite at a concentration of 169 mg/kg. It is not known if these concentrations are the result of site-related burning activities, geology, or agriculture. It should be noted that the area, including the test pits with high nitrate/nitrite concentrations, has been used extensively in the past for cattle grazing, which also may be a source of nitrates (PRC/Montgomery Watson 1993a). These three test pits are not located in gullies where most of the burning activities took place. Therefore, the nitrate/nitrite levels in the soil samples from these pits most likely resulted from cattle grazing rather than from burning.

Metals detected at concentrations greater than the AM/3SD may be present in the soil as a result of site activity (Figure 5-10). Soil samples collected from trenches BUA-04-TP, BUA-09-TP, BUA-10-TP, BUA-13-TP, and BUA-04-MWA all contained two or more metals at elevated concentrations that may

be due to site activities. The AM/3SD and 95/95 TI values were used in the SI as benchmarks to identify elevated metals concentrations at the investigation sites. As described in Section 1.4, metals concentrations for RI results are compared to PRGs and ambient values. Section 10.5 discusses all historical samples collected at the site with concentrations in excess of the PRG values. The SI samples with the highest concentrations of metals occur mostly along the northeast part of the site, and lower metal concentrations are prevalent to the southwest (PRC/Montgomery Watson 1993a). These apparently elevated metals concentrations may reflect site-specific conditions that are a result of past site activities. Soil samples from borings BUA-01-MWA and BUA-02-MWA contained metal at concentrations greater than their respective 95/95 TI values, but below the AM/3SD reference levels. These borings were located outside of the boundaries of the site, well away from any visible surface debris.

To assess whether site-related activities had affected groundwater quality beneath and downgradient of the site, five groundwater monitoring wells were planned to be installed and sampled using a hollow stem auger drill rig. However, because hydrologically confined conditions were unexpectedly encountered at Site 13, only one well was installed and sampled (PRC/Montgomery Watson 1993a). Monitoring wells were not installed at locations where confined conditions were observed because of concern that water rising in the borehole could result in cross contamination of permeable zones above the water-bearing zone. Well BUA-02-MWA was installed to a depth of 26 feet bgs at the northwest corner of the site where confined conditions were not observed. Following the SI, groundwater samples collected during two successive rounds were analyzed for explosive chemicals, nitrate/nitrite, metals, aromatic VOCs, conductivity, hardness, TPH, pH, TOC, and TSS.

#### **5.4 REMEDIAL INVESTIGATION FIELD ACTIVITIES**

Soil and groundwater samples were collected at the Burn Area to assess whether ordnance burning has affected environmental media at the site. To compare burned areas to areas unaffected by burning, sampling was conducted both in the gullies where burning has taken place and at random locations outside the gullies. Site drainage channels were sampled to assess whether contaminants are being transported off the site by surface water flow.

To address the spatial extent of contaminants, the site was divided into six areas that are made distinct by past site activities, drainage features, and investigation approach. These areas are (1) gullies and revetments where burning may have taken place; (2) randomly assigned grid points that may have been affected by site activities, but where burning is not known to have occurred; (3) the surface soils of site drainage channels; (4) contingency locations at trench excavations where soils were further characterized to assess the extent of visually observed contamination; (5) deep soil borings completed as monitoring wells; and (6) the east (upslope) area of the site grid, where soil samples were collected to establish ambient metals concentrations. These sampling areas are discussed in Sections 5.4.2 through 5.4.7.

#### **5.4.1 Site Reconnaissance Activities**

Site reconnaissance activities consisted of a visual inspection of sampling locations, a biological/ecological clearance, an explosive ordnance clearance, and a utility clearance, the latter conducted by NWS Concord personnel and representatives of the concerned utilities. The procedures of the biological/ecological clearance are discussed in the FSP (PRC/ Montgomery Watson 1995b). An explosive ordnance clearance was conducted at all sampling locations to identify potential explosive hazards during the investigation. The explosive ordnance clearance identified three pieces of UXO at trench excavation BUATP024, which were removed from the planned trenching area. A live tracer element was later discovered during surface sampling at BUATP024. This location was sampled without further disturbing the tracer. The site UXO report is included in Appendix F.

#### **5.4.2 Trench Excavations**

Trenches were excavated across the gullies where burning may have occurred to document soil conditions and to collect soil samples from the areas most likely to have been altered by site activities. Twenty-four trenches (BUATP020 through BUATP030 and BUATP032 through BUATP044, Figure 5-11) were excavated to depths of approximately 5 feet bgs, and soil samples were collected from the undisturbed surface, the side wall, and the floor of each trench. Sampling in the trench excavations was biased toward areas of visibly stained soil. The trench excavations were backfilled once sampling was complete. The 72 soil samples were analyzed for SVOCs, TPH-E, metals, nitrate/nitrite, and pH. The 48 subsurface soil samples were also analyzed for VOCs. Trench excavation cross sections are presented in

Appendix C. Geological interpretations of the site based on trench observations are discussed in Section 5.2.2.

#### **5.4.3 Surface Soil Sampling**

Surface soil samples BUASB006 through BUASB010 were collected along the drainage channel at the base of the hill at the western side of the site to assess whether chemicals are being transported off site by surface runoff. The samples were analyzed for SVOCs, TPH-E, metals, nitrate/nitrite, and pH.

#### **5.4.4 Geoprobe Borings**

Geoprobe borings were drilled at 20 unbiased locations on a grid that covered the entire site (Figure 5-11). The results of unbiased sampling provide an indication of the degree of soil contamination in the areas outside of the burn trenches. The grid was composed of 36 250- by 250-foot sections. Soil samples were collected at the surface and at a depth of approximately 3 feet bgs and were analyzed for SVOCs, TPH-E, metals, nitrate/nitrite, and pH. In addition, surface soil samples were analyzed for low-level SVOCs, and the subsurface soil samples were analyzed for VOCs.

Five additional Geoprobe borings, BUASB001 through BUASB005, were advanced to evaluate site conditions in areas of burning. The five additional Geoprobe borings were drilled in the trench excavation where visibly stained soil appeared to continue deeper than the excavation depth of 5 feet bgs. Borings BUASB001 and BUASB002 were drilled near trench BUATP024; borings BUASB003 and BUASB004 were drilled near trench BUATP044; and boring BUASB005 was drilled near trench BUATP039 (Figure 5-11). Soil samples were collected at the surface and at depths of approximately 5 and 10 feet bgs from all of the borings. One sample was also collected from a depth of approximately 15 feet bgs from boring BUASB004. All 16 soil samples were analyzed for VOCs, SVOCs, TPH-E, metals, nitrate/nitrite, and pH. As a follow-up to sampling conducted during the RI, six Geoprobe borings, BUASB011 through BUASB016, were drilled to further assess lead in the soil at two of the trench excavations with elevated lead concentrations. Geoprobe borings BUASB011 through BUASB013 were drilled in the area of trench BUATP024, and borings BUASB014 through BUASB016 were drilled in the area of trench BUATP039. Soil samples were collected at the surface and at a depth of 3 feet bgs and were analyzed for lead.

Eight Geoprobe borings were drilled at ambient locations. As described in Appendix A, the metal concentrations from these samples were used to determine ambient metal concentrations. Borings BUASBG01, BUASBG03, BUASBG05, BUASBG07, and BUASBG10 through BUASBG13 were located at the upslope side of the site along the easternmost grid line (Gridline G, Figure 5-11). Soil samples were collected at the surface and at a depth of 10 feet bgs from each of these borings. Soil samples were also collected at 3 feet bgs in selected soil borings. The ambient soil samples were analyzed for metals and pH. Analytical results for soil samples are presented in Table 5-2.

#### **5.4.5 Monitoring Well Soil Borings**

Three soil borings, BUAMW010 through BUAMW012, were drilled to install monitoring wells both upgradient and downgradient of the pits (Figure 5-11). Boring BUAMW011 was drilled east of the site in the anticipated upgradient direction. Borings BUAMW010 and BUAMW012 were drilled in the anticipated downgradient direction from the site, near Wake Way. Soil samples were collected at surface and at a depth of approximately 5 feet bgs from each monitoring well boring and soil samples were collected at approximately 10 feet bgs from borings BUAMW011 and BUAMW012. These eight soil samples were analyzed for VOCs, SVOCs, TPH-E, metals, nitrate/nitrite, and pH. A soil sample from each monitoring well boring was collected at the water-bearing zone and analyzed for total organic carbon (TOC) and geotechnical parameters.

#### **5.4.6 Monitoring Well Installation**

Soil borings were drilled by West Hazmat Drilling Corporation of Newark, California (State of California Well Driller C57 License #554979), using an air rotary casing hammer drill rig. The air rotary casing hammer rig was used to prevent cross-contamination of different hydrogeologic units encountered at Site 13 during the SI. The three deep soil borings, BUAMW010 through BUAMW012 (Figure 5-11), were completed as groundwater monitoring wells. Monitoring wells were constructed with 4-inch diameter Schedule 40 PVC well casings. Wells were screened with 0.010-inch slotted casings. Screens were placed in the saturated zone in each soil boring. A filter pack consisting of No. 2/16 Monterey Sand was placed 2 to 7 feet above the top of the screen interval. The monitoring wells were seated with a 3-foot layer of hydrated bentonite chips, followed by neat cement grout to the ground surface. Well completion diagrams are included as Appendix G. The wells were constructed and developed in



accordance with the procedures outlined in the FSP (PRC/Montgomery Watson 1995b). Records of well development are included as Appendix H.

#### **5.4.7 Groundwater Sampling**

Within two weeks of well installation in June 1995, unfiltered groundwater samples were collected from wells BUAMW010 through BUAMW012 and analyzed for VOCs, SVOCs, TPH-E, metals, conductivity, hardness, pH, TOC, and TSS. In addition, unfiltered groundwater from well BUAMW002, installed during the SI, and UNOCAL wells BUAMU01, BUAMU02, BUAMU04, BUAMU05, were collected in conjunction with the sampling of the newly installed wells. A second round of groundwater sampling was conducted in September 1995. Groundwater sampling forms are included in Appendix E.

#### **5.4.8 Summary of Quality Assurance/Quality Control Field Procedures**

Field QA/QC sampling conducted during the field effort at Site 13 consisted of the collection of field duplicates, referee duplicates, field blanks, equipment rinsates, and trip blanks in accordance with the FSP (PRC/Montgomery Watson 1995b). The results of these QA/QC samples are discussed in the QCSR (Appendix I). Field equipment was decontaminated in accordance with the procedures outlined in the FSP (PRC/Montgomery Watson 1995b). Field instruments used during the field effort were calibrated and maintained in accordance with the QAPjP (PRC/Montgomery Watson 1995c). Borings, trenches, and samples collected were documented in accordance with the WP and the FSP (PRC/Montgomery Watson 1995a,b).

#### **5.4.9 Deviations from Proposed Investigation Approach**

Proposed trench BUATP031 was not excavated because cleanup of the area was proposed in lieu of sampling. This trench was proposed for the area where napalm was detected during the SI. A work plan proposing excavation of the napalm and underlying soils was approved by EPA, RWQCB, and DTSC in September 1996. The excavation will be conducted in September 1997 and will be followed by confirmation sampling to verify removal of the contaminated soil.

Low-level SVOCs (consisting of CLP methods with minor modifications to achieve low detection limits on an expanded analyte list) were added to the suite of analyses for surface soil samples collected at the grid locations. Surface samples were analyzed for low-level SVOCs and PCB/pesticides to achieve low detection limits comparable to ERL/ERM screening criteria and to help better characterize the site for the ecological risk assessment.

## **5.5 CHEMICAL CHARACTERIZATION**

Soil and groundwater sampled during the RI at Site 13 were submitted for the laboratory analyses described in Section 5.4 above and as presented in Tables 5-2 and 5-3. The analytical results of sampling are presented in Appendix J.

### **5.5.1 Results of Soil Sample Analyses**

This section presents the significant results of the soil sampling effort at Site 13. Soil samples were collected from trench excavations, monitoring well boreholes, Geoprobe borings, and at the ground surface at the locations described in Section 5.4. The results of soil sampling are compared to the PRG values established for residential soils (EPA 1995), included in Appendix L. The soil results are also compared to TTLC values defined in Title 22 of the California Code of Regulations. TTLC values are used to categorize waste. If concentrations exceed the TTLC values, then the waste is defined to exhibit the characteristic of toxicity. In this RI, the TTLC values are not used to characterize waste, but instead are used to compare to soil concentrations to locate any hot spots (areas of unusually high concentrations). The chemicals with concentrations exceeding these criteria are the only chemicals discussed in the following sections, and these chemicals are carried into the human health risk assessment (HHRA). No PRG values have been established for TPH constituents, and thus they are evaluated qualitatively.

#### **5.5.1.1 Organic Compounds in Soils**

No organic compounds exceeded the TTLC values. Organic compounds detected in Site 13 soils at concentrations exceeding PRG values, as well as all TPH detections, are shown on Figure 5-12.

VOCs were detected in only two soil samples (Table 5-4), however, not at levels that exceeded PRGs.

SVOCs were quantified by the CLP SVOC method and by the low-level SVOC method, the latter of which was conducted to achieve detection limits near ecological screening criteria. Trench excavation samples BUATP025 (1.75 feet bgs) and BUATP033 (0.5 feet bgs) contained benzo(a)pyrene at concentrations of 0.270 and 0.070 mg/kg, respectively, which exceed the PRG value of 0.061 mg/kg (Table 5-5). No other samples collected at the Burn Area contained SVOCs at concentrations exceeding PRG values. No SVOCs were detected in the samples collected from the monitoring well borings. No SVOCs were detected in the drainage channel soil samples, indicating that these compounds detected in site soils are not likely being transported off site.

TPH-D was detected in only four soil samples, BUAMW012 (two samples, collected at 5.0 to 5.5 and 10.0 to 10.5 feet bgs), BUATP024 (0.25 feet bgs), and BUASB002 (surface) at concentrations up to 23 mg/kg (Table 5-6). TPH-motor oil was detected in trench excavation surface samples collected from BUATP033, BUATP036, BUATP038, and BUATP040 through BUATP043 at concentrations exceeding 100 mg/kg, with concentrations in trenches BUATP041 and BUATP042 of 1,700 and 1,100 mg/kg, respectively. TPH-motor oil was detected in two monitoring well soil samples from BUAMW012 (surface and 10.0 to 10.5 feet bgs) and the grid surface sample at BUASBE03 at concentrations of 430, 110, and 130 mg/kg, respectively. All other detections of TPH-motor oil were at concentrations less than 100 mg/kg. TPH-motor oil was detected in drainage channel surface soil samples BUASB006, BUASB007, and BUASB010 at concentrations up to 22 mg/kg, indicating that heavy petroleum compounds are probably being transported off site.

#### **5.5.1.2 Inorganic Compounds in Soil**

The ambient metal concentrations for Site 13 were calculated from metal concentrations detected in ambient soil samples (Appendix A). Inorganic compounds detected in Site 13 soils at concentrations exceeding PRG values and arsenic detections greater than ambient levels are shown on Figure 5-13. The metals antimony, arsenic, barium, beryllium, cadmium, lead, and nickel were detected in soils collected at the Burn Site at concentrations exceeding PRG values (Table 5-7). For metals other than arsenic, detections greater than the PRG are also above ambient values. The distribution of antimony, arsenic, barium, beryllium, cadmium, lead, manganese, and nickel in site soil samples is discussed below.

### **Antimony**

Antimony was detected at a concentration of 84.2 mg/kg in trench excavation soil sample BUATP024 (0.25 feet bgs), which exceeds the PRG value of 31 mg/kg. Antimony was also detected at concentrations exceeding the site ambient value of 0.9 mg/kg in soil samples collected from six additional trench excavations, two contingency borings, and one monitoring well boring. No antimony was detected at concentrations exceeding the ambient value in soil samples collected from the ambient locations, drainage ditch, or grid locations.

### **Arsenic**

Arsenic was detected in the majority of the soil samples collected at the Burn Area at concentrations exceeding its PRG. However, site ambient concentrations of arsenic greatly exceed the PRG (15 mg/kg compared to 0.38 mg/kg) and only four arsenic concentrations exceeded the site ambient value, indicating that arsenic concentrations in this area of NWS Concord are indigenous to the site.

### **Barium**

Barium was detected at a concentration of 18,300 mg/kg in the soil sample collected from trench excavation BUATP039 (3.0 feet bgs), which exceeds the PRG value of 5,300 mg/kg and the TTLC of 10,000 mg/kg. Barium was also detected at concentrations exceeding the site ambient value of 560 mg/kg in soil samples collected from two additional trench excavations, five grid locations (including two ambient borings), and three contingency borings. Barium was not detected at concentrations exceeding the ambient value in the soil samples collected from the monitoring well borings or drainage ditch locations.

### **Beryllium**

Beryllium was detected at concentrations exceeding the PRG value of 0.14 mg/kg and the ambient value of 0.12 mg/kg in soil samples collected at 17 trench excavations, 4 contingency borings, and 1 drainage ditch location at concentrations up to 1.0 mg/kg (trench excavation soil sample BUATP037, 4 feet bgs).

Beryllium was not detected at concentrations exceeding the ambient value in soil samples collected from the monitoring well borings, grid locations, or ambient locations.

### **Cadmium**

Cadmium was detected in the surface soil sample collected at contingency boring BUASB002 at a concentration of 15.7 mg/kg, which exceeds the PRG value of 9.0 mg/kg. Cadmium was also detected at concentrations exceeding the site ambient value of 0.28 mg/kg in soil samples collected from 10 trench excavations, four grid locations, and one ambient location. Cadmium was not detected at concentrations exceeding the ambient value in soil samples collected from the monitoring well borings or drainage ditch locations.

### **Lead**

Lead was detected in soil samples collected from four trench excavations and three soil borings at concentrations exceeding the PRG value of 130 mg/kg. Lead was detected at concentrations exceeding the TTLC of 1,000 mg/kg in two trench excavation soil samples BUATP024 (0.25 feet bgs) at a concentration of 5,590 mg/kg and BUATP039 (3.0 feet bgs) at a concentration of 3,090 mg/kg. Three additional soil borings were taken as confirmation samples near these two hot spots. Two soil samples were collected from each of these borings at surface and 3 feet bgs. Figure 5-14 shows the lead concentrations from the original borings as well as the lead concentrations from the confirmation samples. The lead concentrations from the confirmation samples ranges from 4.9 to 235 mg/kg, with 12 of the 13 confirmation samples having concentrations less than 100 mg/kg. This lead distribution indicates that the lead hot spots are isolated. The source of the lead is most likely from lead associated with bullets or ordnance. Lead was also detected at concentrations exceeding the site ambient value of 32 mg/kg in soil samples collected from seven additional trench excavations, two additional contingency borings, and one ambient sample. Lead was not detected at concentrations exceeding the ambient value in soil samples collected from the grid locations, monitoring well borings, or drainage ditch locations.

## **Manganese**

Manganese was detected in the soil sample collected from ambient location BUASBG05 (3.0 to 3.5 feet bgs) at a concentration of 5,150 mg/kg, which exceeds the PRG value of 3,200 mg/kg. This concentration of manganese was not used to determine the ambient value for manganese because it meets the criteria as an outlier (Appendix A). Additionally, this concentration is not considered to represent site conditions because it is from a boring located away from site activities. Manganese was not detected in any other samples at concentrations exceeding the PRG. Manganese was detected at concentrations exceeding the site ambient value of 1,300 mg/kg in soil samples collected from six trench excavations, one additional ambient/grid location, one ambient location, and one contingency boring. Manganese was not detected at concentrations exceeding the ambient value in soil samples collected from the monitoring well borings or drainage ditch locations.

## **Nickel**

Nickel was detected in soil samples collected from two samples from one trench excavation, one ambient location, and one ambient/grid location at concentrations exceeding the PRG value of 150 mg/kg. Nickel was detected in trench excavation soil samples BUATP027 (2.0 and 3.5 feet bgs) at concentrations of 244 and 361 mg/kg, the latter sample having highest concentration detected at the site. Nickel was also detected at concentrations exceeding the site ambient value of 100 mg/kg in soil samples collected from two additional trench excavations. Nickel was not detected at concentrations exceeding the ambient value in soil samples collected from the monitoring well borings, contingency samples, or drainage ditch locations.

### **5.5.2 Results of Groundwater Analyses**

Unfiltered groundwater samples were collected from monitoring wells installed by the Navy as part of the SI and RI, and from wells owned by UNOCAL that were installed as part of an investigation unrelated to Burn Area activities. Monitoring wells were sampled at the locations and times described in Section 5.4. This section presents the significant results of the groundwater sampling effort at Site 13. The results of groundwater sampling are compared to the PRGs established for drinking water (EPA 1995; Appendix L). No PRGs have been established for TPH concentrations.

### **5.5.2.1 Organic Compounds in Groundwater**

No organic compounds were detected in the samples collected in the first round of groundwater sampling. TPH-D was detected at concentrations of 0.08 and 0.12 milligrams per liter (mg/L) in the second-round samples collected from wells BUAMW010 and BUAMW011, respectively (Table 5-8). TPH constituents detected in Site 13 groundwater samples are shown on Figure 5-15. The SVOC 4-methylphenol was detected in the second-round sample collected from BUAMW010 at a concentration of 6 micrograms per liter ( $\mu\text{g/L}$ ), which is less than the PRG value of 180  $\mu\text{g/L}$ . No other organic compounds were detected in groundwater samples collected at the site.

### **5.5.2.2 Inorganic Compounds in Groundwater**

Manganese was the only metal detected at concentrations exceeding the PRG value in groundwater samples collected during at least one of the sampling rounds (Table 5-9).

#### **Manganese**

Manganese was detected in the samples collected from well BUAMW010 during the second sampling round at a concentration of 3,130  $\mu\text{g/L}$ , which exceeds the PRG value of 1,700  $\mu\text{g/L}$ .

### **5.5.3 Summary of Chemical Characterization**

As stated in Section 5.4, the site was divided into six study areas to assess the spatial extent of chemicals at the site. This section summarizes the organic and inorganic chemicals detected within the five study areas associated with site activities and site drainage, and the sixth area, where ambient soil samples were collected to calculate ambient metal concentrations. Analytical results relating to the site as a whole are summarized prior to the summary discussions of the individual study areas.

No VOCs were detected in the soil samples collected at the Burn Area at concentrations greater than PRG values. SVOCs were detected in samples from trench excavations, grid borings, and contingency borings. TPH-D was detected in samples from trench excavations, grid borings, and monitoring well

borings. TPH-motor oil was detected in samples from trench excavations, monitoring well borings, and drainage ditches.

The metals antimony, arsenic, barium, beryllium, cadmium, lead, manganese, and nickel were detected in soils collected at the Burn Site at concentrations exceeding the PRG values. Arsenic concentrations exceeding PRG values are probably indigenous to the site.

### **Trench Excavations and Trench Borings**

The SVOC benzo(a)pyrene was detected in two trench excavation soil samples at concentrations exceeding PRG values. No other samples collected at the Burn Area contained SVOCs at concentrations exceeding PRG values. Elevated petroleum hydrocarbon concentrations at the Burn Area are strongly correlated with the trench excavations. TPH-motor oil was detected in the trench surface at concentrations up to 1,700 mg/kg.

The metals antimony, beryllium, cadmium, copper, lead, mercury, and zinc were detected at concentrations exceeding PRGs, ambient values, or both with greater frequency in the trench excavations and contingency borings, where burning at Site 13 was concentrated; therefore, the distribution of these metals is likely the result of site activities. Trench excavations BUATP024, BUATP027, BUATP033, BUATP039, BUATP043, and BUATPT044, and contingency borings BUASB002 and BUASB003 had the highest frequency of metals at elevated concentrations. The lead hot spots in BUA-24C-TP and BUA-39C-TP are isolated and are most likely from lead associated with bullets or ordnance.

### **Grid Locations**

Infrequent detections of metals at concentrations exceeding ambient values in downslope grid locations indicate that the metals detected at the trench excavations and upslope areas are not being transported off site.



### **Drainage Channels**

No SVOCs were detected in the drainage channel soil samples, indicating that these compounds detected in site soils are not likely being transported off site. TPH-motor oil was detected in three drainage channel surface soil samples at concentrations up to 22 mg/kg. Infrequent detections of metals at concentrations exceeding ambient values in drainage ditch locations indicate that the metals detected at the trench excavations and upslope areas are not being transported off site.

### **Monitoring Wells (Deep Soil Borings)**

Infrequent detections of metals at concentrations exceeding ambient values in downslope monitoring well soil samples indicate that the metals detected at the trench excavations and upslope areas are not being transported off site.

No organic compounds were detected in the samples collected in the first round of groundwater sampling. TPH-D was detected at concentrations up to 0.1 mg/L in second-round samples collected from wells BUAMW010 and BUAMW011. No other organic compounds were detected in groundwater samples collected at the site. Manganese was detected in the samples collected from well BUAMW010 during the two sampling rounds and manganese was detected in the sample collected from well BUAMW011 during the second sampling round at concentrations exceeding the PRG value.

### **Ambient Evaluation Borings**

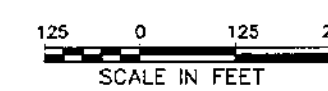
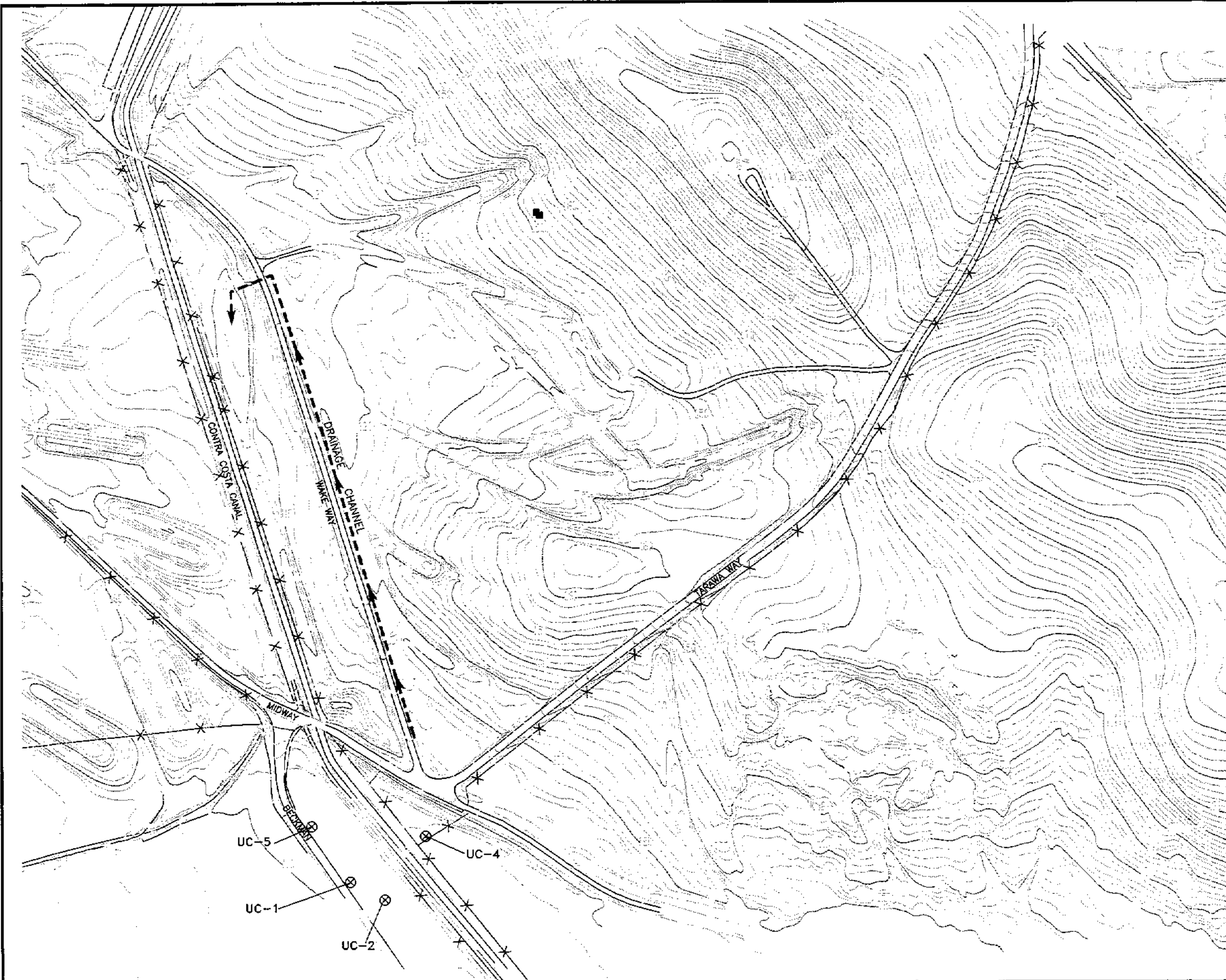
The relatively frequent occurrence of metals concentrations exceeding the estimated ambient values in the upslope ambient soil samples may reflect changes in lithology/sedimentology with elevation. The borings drilled to evaluate the ambient values are located well away from the disposal or burn trenches and gullies and are believed to be unaffected by site activities.

## **5.6 REVISED CONCEPTUAL SITE MODEL**

The conceptual site model was developed after the SI and is presented in the WP (PRC/Montgomery Watson 1995a). This conceptual site model has been updated to include the RI data. The model lists

potential sources and the chemicals of potential concern (COPC) identified in Section 5.5, and highlights the most likely migration routes (Figure 5-15). The model is used in conjunction with the results from the human health and ecological risk assessments and the fate and transport properties of the organic COPCs to assess site conditions and the need for remediation. Based on historical information and analytical data, munitions powders, flares, and napalm were burned in the area. Because hydrocarbons were likely used only for igniting fires and the area was not used for fuel/solvent storage, it was not expected that large amounts of chemicals were released that would move as nonaqueous phase liquids deeper into soils. Chemicals may be transported off site as a result of alluvial transport of soil with sorbed chemicals and possibly by leaching. The volatilization pathway is not significant, because only two VOCs (xylene and chloroform) were detected in samples at Site 13. The concentration of these VOCs were below PRGs. Wind transport is a potential pathway but soil erosion is minimized by the dense grass vegetative cover which exists at the site.

The presence of chemicals at the site was consistent with the conceptual site model. The presence of TPH, TPH constituents, SVOCs, and localized elevated concentrations of metals is consistent with ordnance burning. The absence of munitions chemicals is consistent because these chemicals are highly reactive and are efficiently destroyed during burning. Ten surface soil samples from Site 13 were analyzed for dioxins and furans (Table 5-2); none of these samples contained detectable concentrations. Napalm was encountered in one trench, which is believed to be the location of fire training activities. Minor ordnance fragments (for example, bullets and flare casings) were encountered during the RI, indicating that burning, and not explosive ordnance demolition, was the major activity at the site.



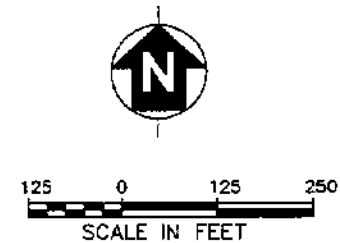
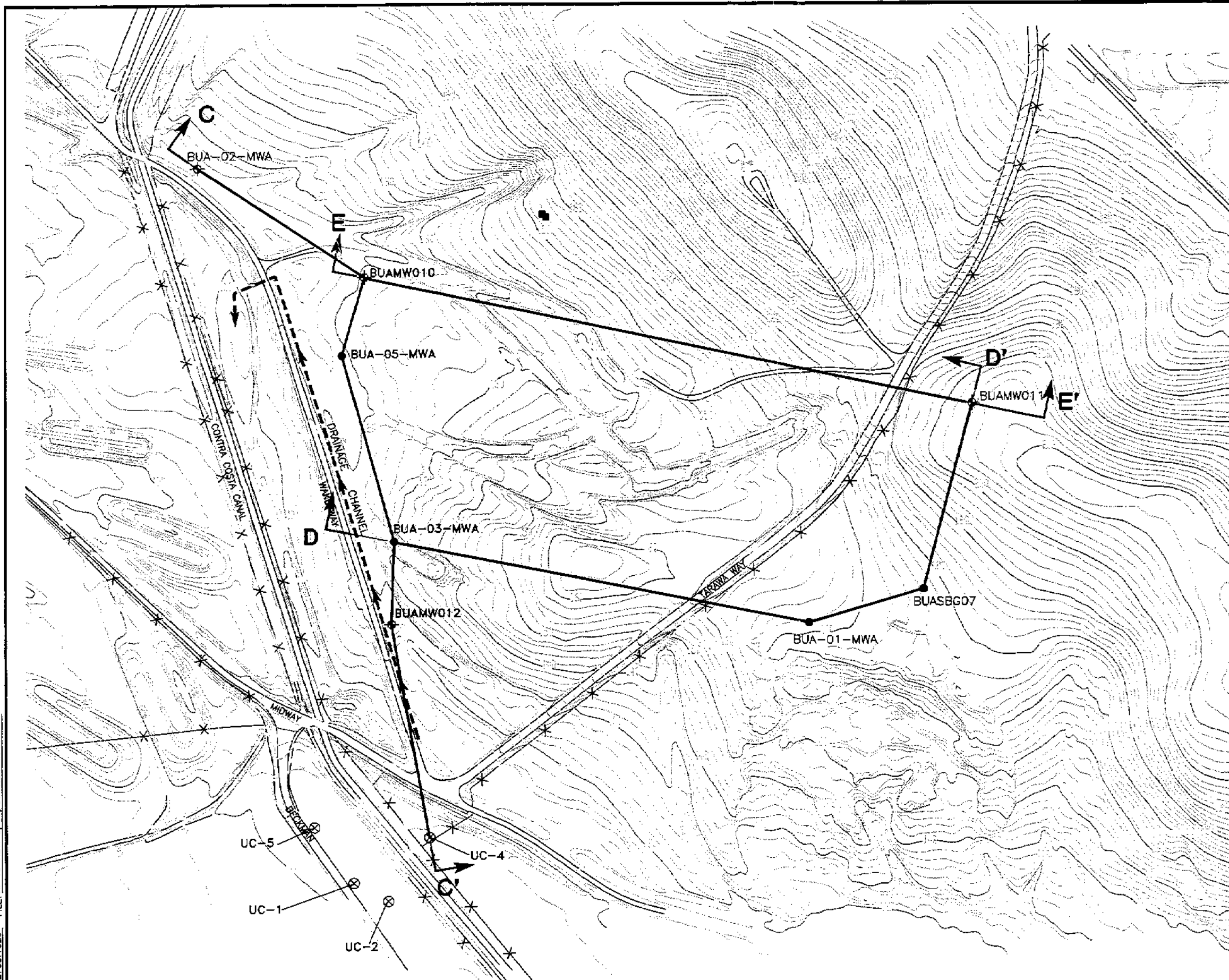
**LEGEND:**

- X — FENCE
- ← --- DRAINAGE CHANNEL (WITH ARROW INDICATING FLOW DIRECTION)
- GROUND SURFACE ELEVATION CONTOUR (FT MSL)
- PIEZOMETER LOCATION (50-110 FT BGS, INSTALLATION DATA UNKNOWN)
- UC-2 ⊗ UNOCAL MONITORING WELLS (0-30 FT BGS, INSTALLED BY GTI, 1991)

NWS CONCORD - INLAND AREA  
CONCORD, CALIFORNIA

**FIGURE 5-1**  
**SITE 13 - BURN AREA**  
**SITE FEATURES**

SIZE	DATE	DWG NAME	REV



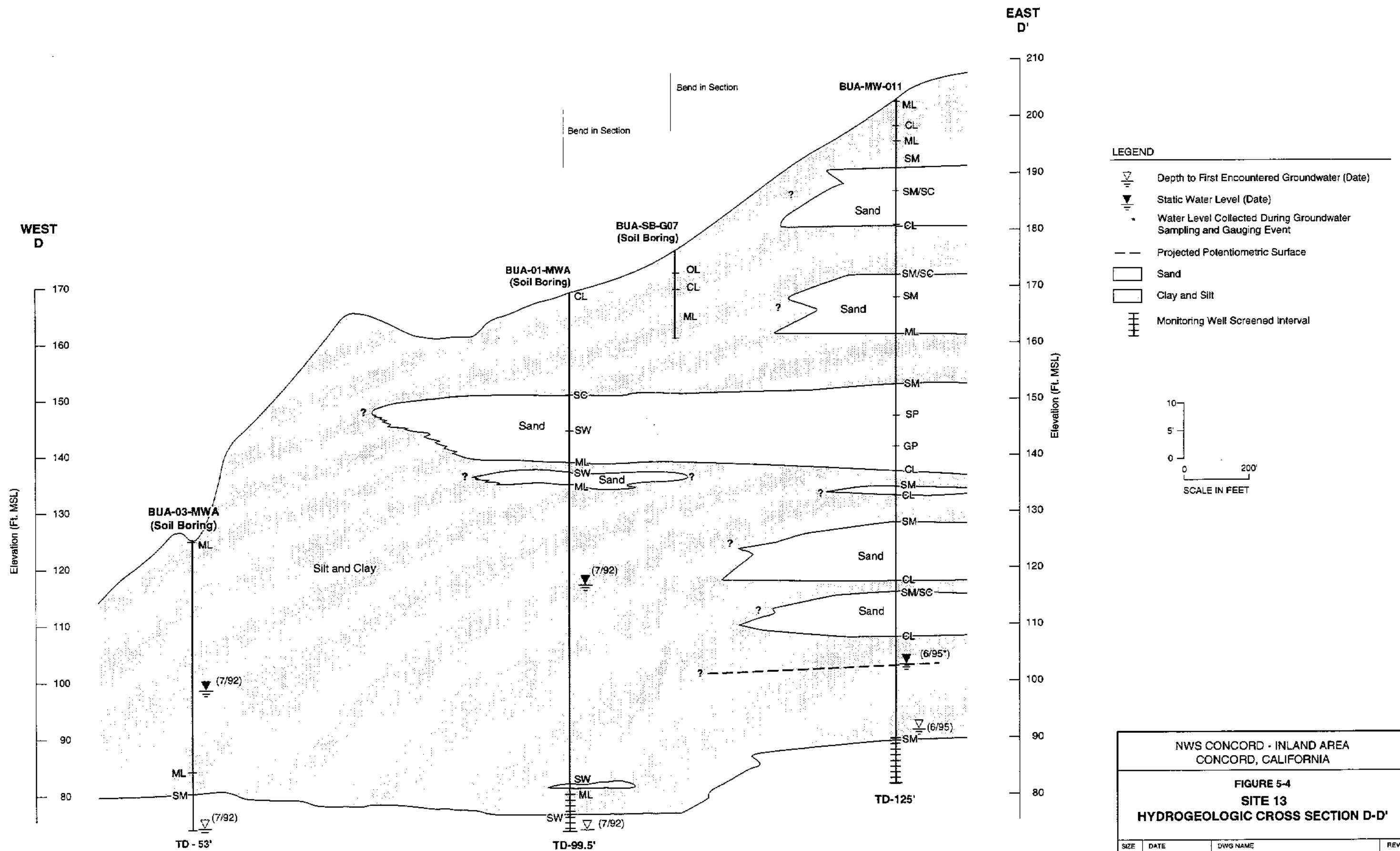
**LEGEND:**

- x — FENCE
- ← --- DRAINAGE CHANNEL (WITH ARROW INDICATING FLOW DIRECTION)
- GROUND SURFACE ELEVATION CONTOUR (FT MSL)
- PIEZOMETER LOCATION (50-110 FT BGS, INSTALLATION DATA UNKNOWN)
- UC-2 ⊗ UNOCAL MONITORING WELLS (0-30 FT BGS, INSTALLED BY GTI, 1991)
- ⊙ MONITORING WELL LOCATION (30 FT BGS)
- SOIL BORING LOCATION (30-100 FT BGS)
- C — C' CROSS SECTION LINE

NWS CONCORD — INLAND AREA  
CONCORD, CALIFORNIA

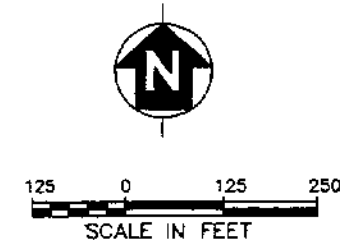
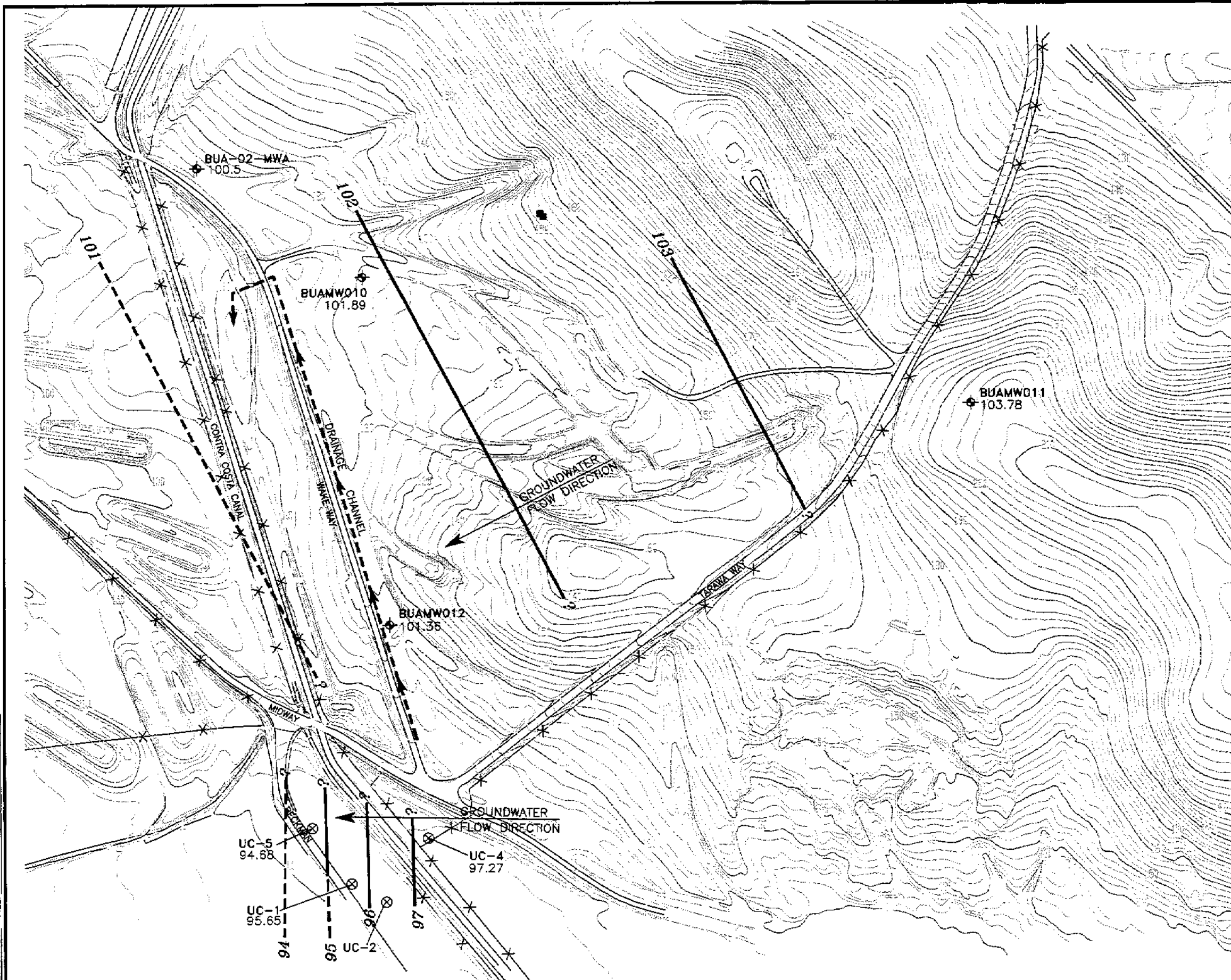
FIGURE 5-2  
SITE 13  
GEOLOGIC CROSS SECTION LINES

SIZE	DATE	DWG NAME	REV









**LEGEND:**

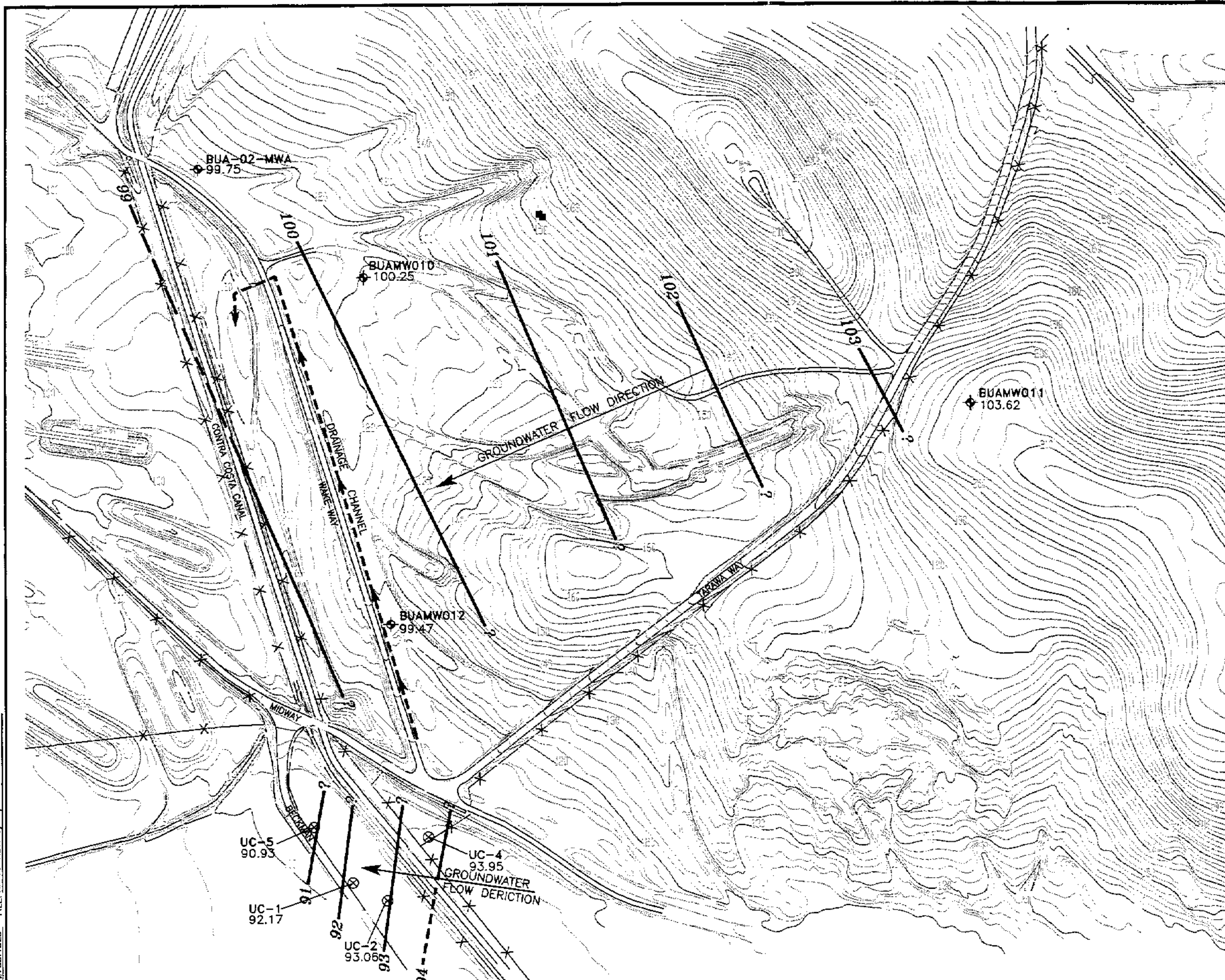
- x — FENCE
- ← --- DRAINAGE CHANNEL (WITH ARROW INDICATING FLOW DIRECTION)
- GROUND SURFACE ELEVATION CONTOUR (FT MSL)
- PIEZOMETER LOCATION (50-110 FT BGS, INSTALLATION DATA UNKNOWN)
- UC-2 ⊗ UNOCAL MONITORING WELLS (0-30 FT BGS, INSTALLED BY GTI, 1991)
- BUA-MW-010 ⊕ MONITORING WELL LOCATION AND GROUNDWATER ELEVATION (FT MSL)
- 101 --- INTERPRETED CONTOUR ON POTENTIOMETRIC SURFACE (FT MSL) DASHED WHERE INFERRED

NOTE:  
IT IS NOT CLEAR WHETHER MONITORING WELL BUA-02-MWA IS HYDRAULICALLY CONNECTED WITH DEEPER WELLS (BUAMW010 THROUGH BUAMW012) BECAUSE IT IS SCREENED AT A SHALLOWER DEPTH. THEREFORE, THE WATER LEVEL ELEVATION FROM WELL BUA-02-MWA WAS NOT USED TO INTERPRET GROUNDWATER CONTOURS.

NWS CONCORD — INLAND AREA  
CONCORD, CALIFORNIA

**FIGURE 5-8**  
**SITE 13-INTERPRETATIVE**  
**GROUNDWATER CONTOURS**  
**JUNE 1995**

SIZE	DATE	DWG NAME	REV



125 0 125 250  
SCALE IN FEET

**LEGEND:**

- x — FENCE
- ← --- DRAINAGE CHANNEL (WITH ARROW INDICATING FLOW DIRECTION)
- 90 — GROUND SURFACE ELEVATION CONTOUR (FT MSL)
- PIEZOMETER LOCATION (50-110 FT BGS, INSTALLATION DATA UNKNOWN)
- UC-2 ⊗ UNOCAL MONITORING WELLS (0-30 FT BGS, INSTALLED BY GTI, 1991)
- BUA-MW-010 103.62 ⊕ MONITORING WELL LOCATION GROUNDWATER ELEVATION (FT MSL)
- 101 - - - INTERPRETED CONTOUR ON POTENTIOMETRIC SURFACE (FT MSL) DASHED WHERE INFERRED

NOTE:  
IT IS NOT CLEAR WHETHER MONITORING WELL BUA-02-MWA IS HYDRAULICALLY CONNECTED WITH DEEPER WELLS (BUAMW010 THROUGH BUAMW012) BECAUSE IT IS SCREENED AT A SHALLOWER DEPTH. THEREFORE, THE WATER LEVEL ELEVATION FROM WELL BUA-02-MWA WAS NOT USED TO INTERPRET GROUNDWATER CONTOURS.

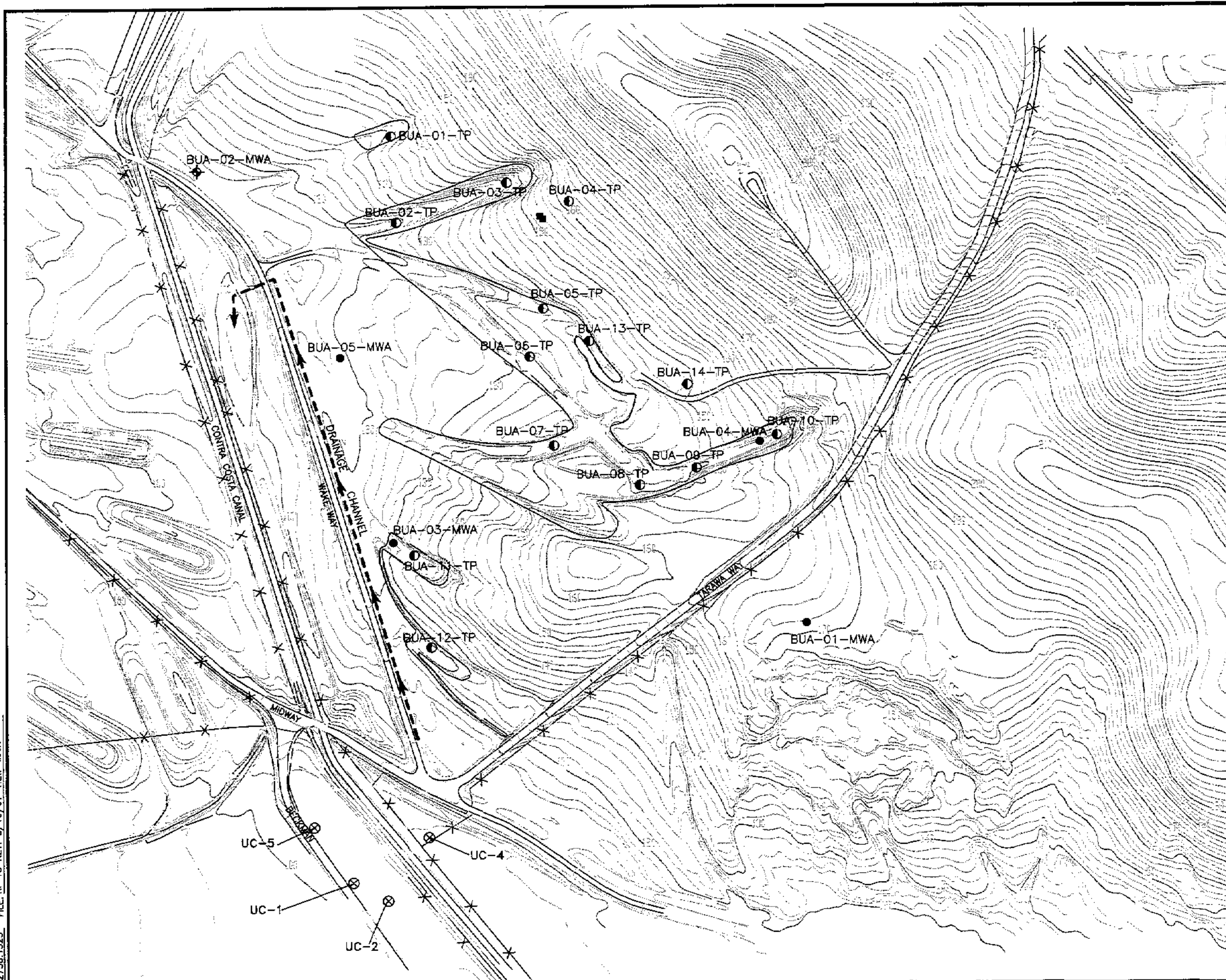
NWS CONCORD - INLAND AREA  
CONCORD, CALIFORNIA

**FIGURE 5-7**  
**SITE 13 - INTERPRETATIVE**  
**GROUNDWATER CONTOURS**  
**SEPTEMBER 1995**

SIZE	DATE	DWG NAME	REV



JOB No. 2738.1325 FILE: RI-13 REV. 8/19/87 VIEW=MAIN



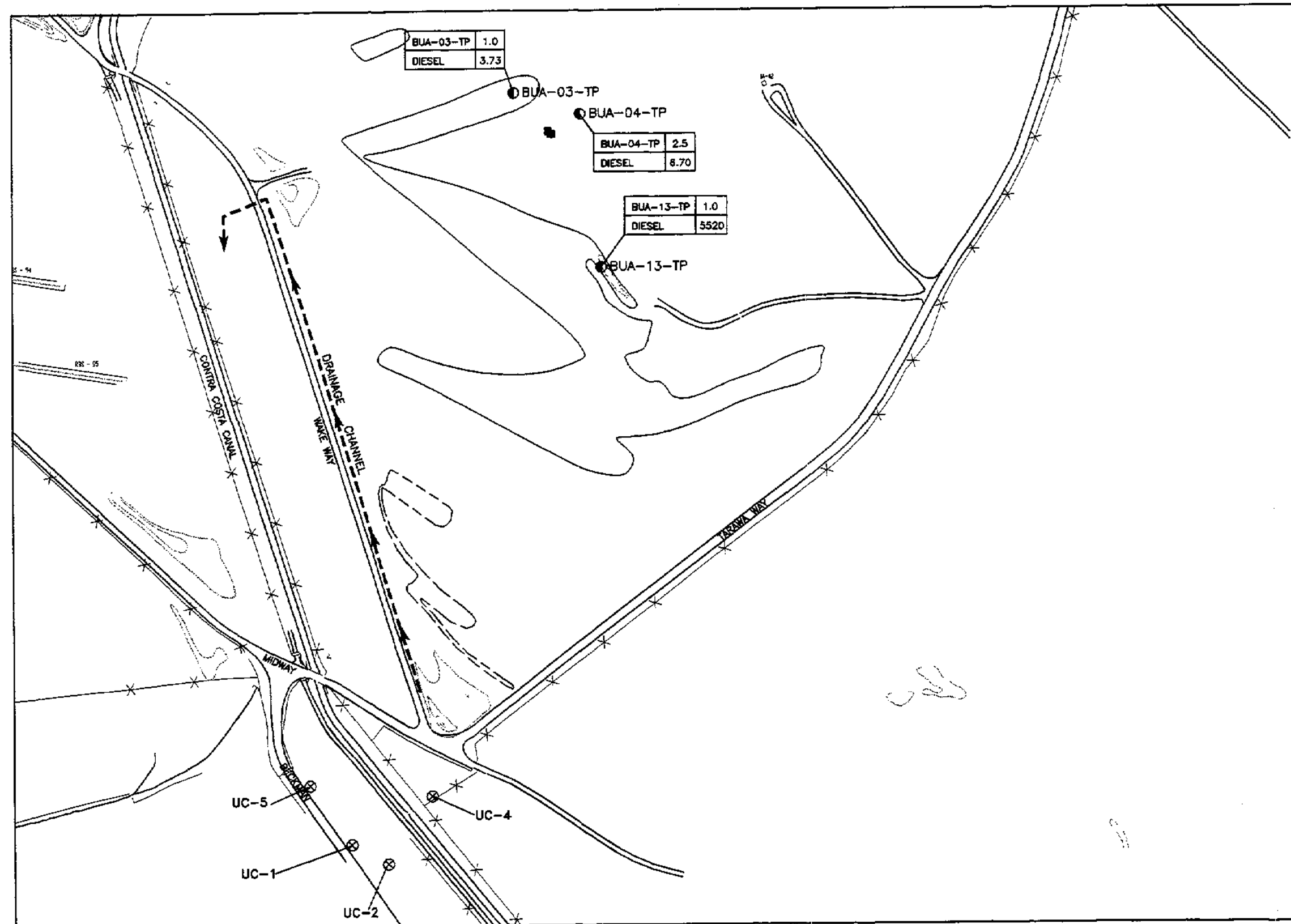
**LEGEND:**

- X — FENCE
- ← --- DRAINAGE CHANNEL (WITH ARROW INDICATING FLOW DIRECTION)
- GROUND SURFACE ELEVATION CONTOUR (FT MSL)
- PIEZOMETER LOCATION (50-110 FT BGS, INSTALLATION DATA UNKNOWN)
- UC-2 ⊗ UNOCAL MONITORING WELLS (0-30 FT BGS, INSTALLED BY GTI, 1991)
- MONITORING WELL LOCATION (30 FT BGS)
- SOIL BORING LOCATION (30-100 FT BGS)
- TEST PIT LOCATION (SAMPLES COLLECTED AT 0.5 AND 2 FT BGS)

NWS CONCORD - INLAND AREA  
CONCORD, CALIFORNIA

**FIGURE 5-8  
SITE 13 - SITE INVESTIGATION  
SAMPLING LOCATIONS**

SIZE	DATE	DWG NAME	REV



# LEGEND:

- TEST PIT LOCATION (SAMPLES COLLECTED AT 1 AND 2.5 FT BGS)
  - PIEZOMETER LOCATION (50-110 FT BGS, INSTALLATION DATA UNKNOWN)
  - UC-2 ● UNOCAL MONITORING WELLS (0-30 FT BGS, INSTALLED BY GTI, 1991)
- 
- 
- 
- 

# NOTES:

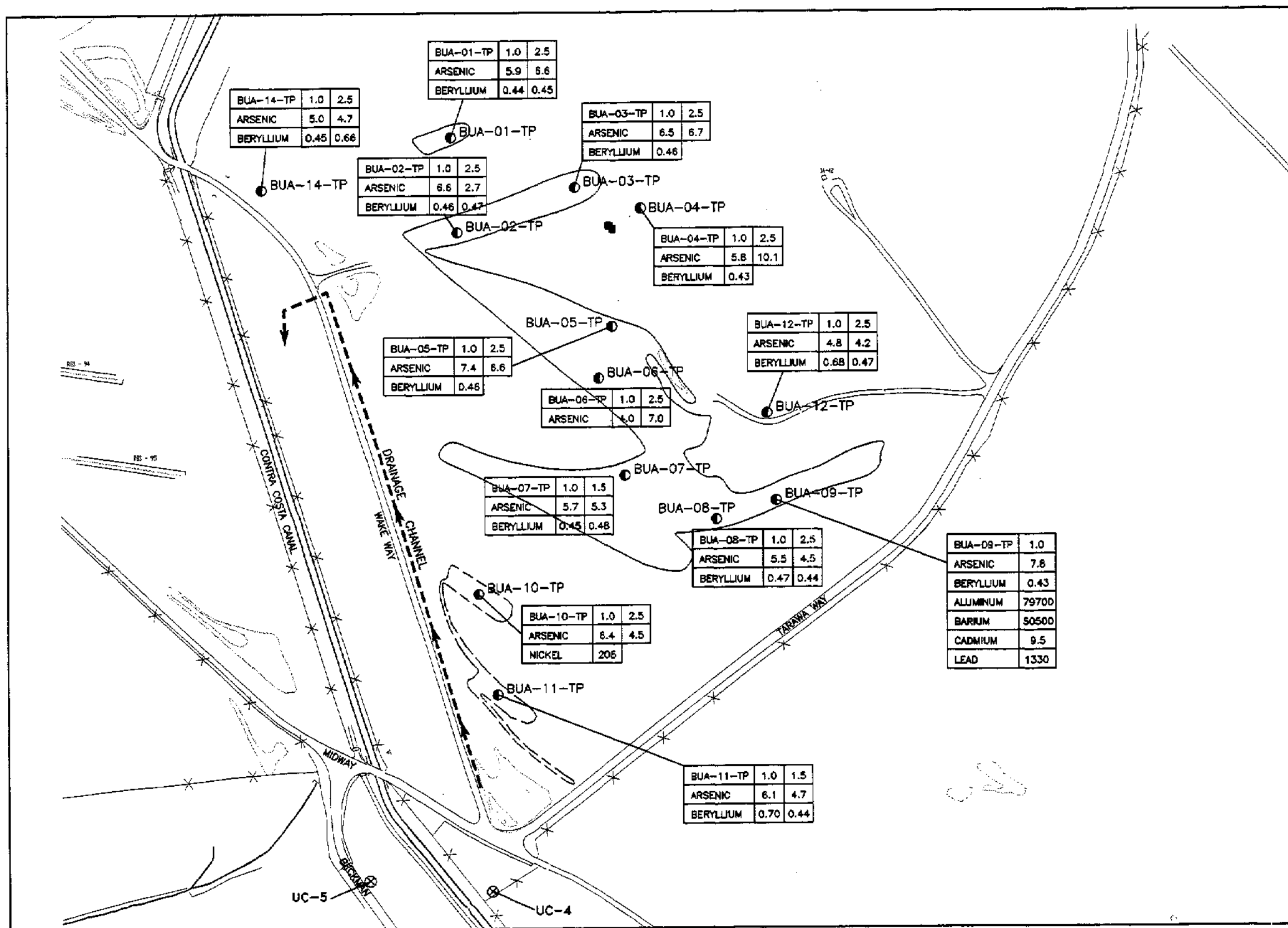
1. ONLY ORGANICS DETECTED AT CONCENTRATIONS EXCEEDING U.S. EPA PRELIMINARY REMEDIATION GOALS FOR RESIDENTIAL LAND USE ARE SHOWN.
2. ALL DETECTED CONCENTRATIONS FOR TPH ARE SHOWN.

NAVAL WEAPONS STATION CONCORD  
CONCORD, CALIFORNIA

FIGURE 5-9

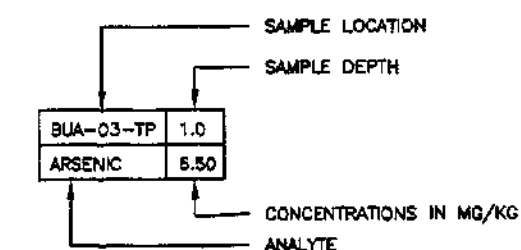
ORGANIC CONSTITUENTS DETECTED  
DURING THE SI AT SITE 13 IN SOIL

SIZE	FROM NO.	DWG NO.	REV
B		SI-130ORGANIC	2



# **LEGEND:**

- TEST PIT LOCATION (SAMPLES COLLECTED AT 1, 1.5, AND 2.5 FT BGS)
- PIEZOMETER LOCATION (50-110 FT BGS, INSTALLATION DATA UNKNOWN)
- UC-2 ● UNOCAL MONITORING WELLS (0-30 FT BGS, INSTALLED BY GTI, 1991)



# **NOTES:**

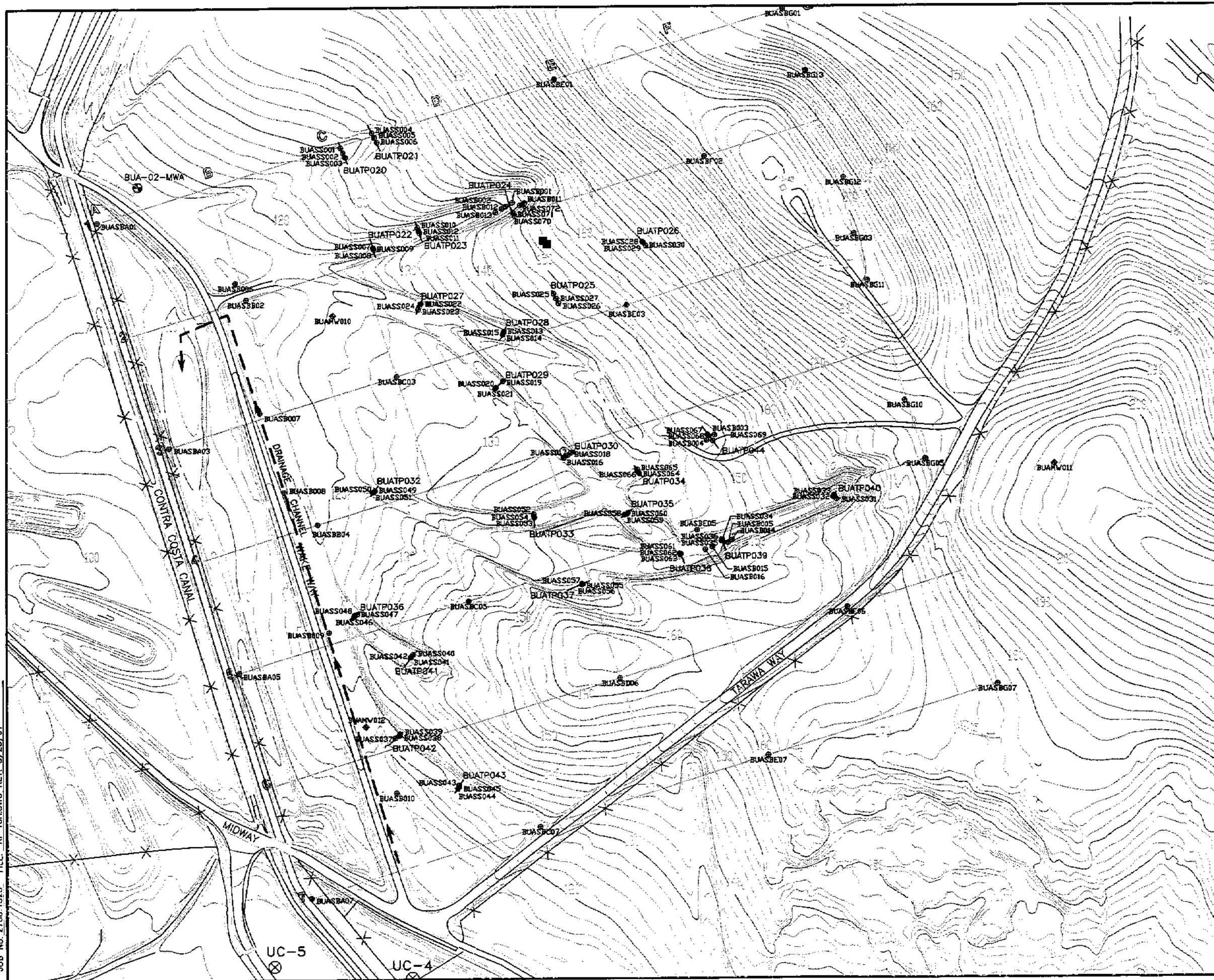
- ONLY INORGANICS DETECTED AT CONCENTRATIONS EXCEEDING U.S. EPA PRELIMINARY REMEDIATION GOALS FOR RESIDENTIAL LAND USE ARE SHOWN.

NAVAL WEAPONS STATION CONCORD  
CONCORD, CALIFORNIA

FIGURE 5-10  
INORGANIC CONSTITUENTS DETECTED  
DURING THE SI AT SITE 13 IN SOIL

SIZE	FROM NO.	DWG NO.	REV
B		SI-13INORGANIC	2

JOB No. 2738.1325 FILE: RI-13A.DWG REV. 8/25/97



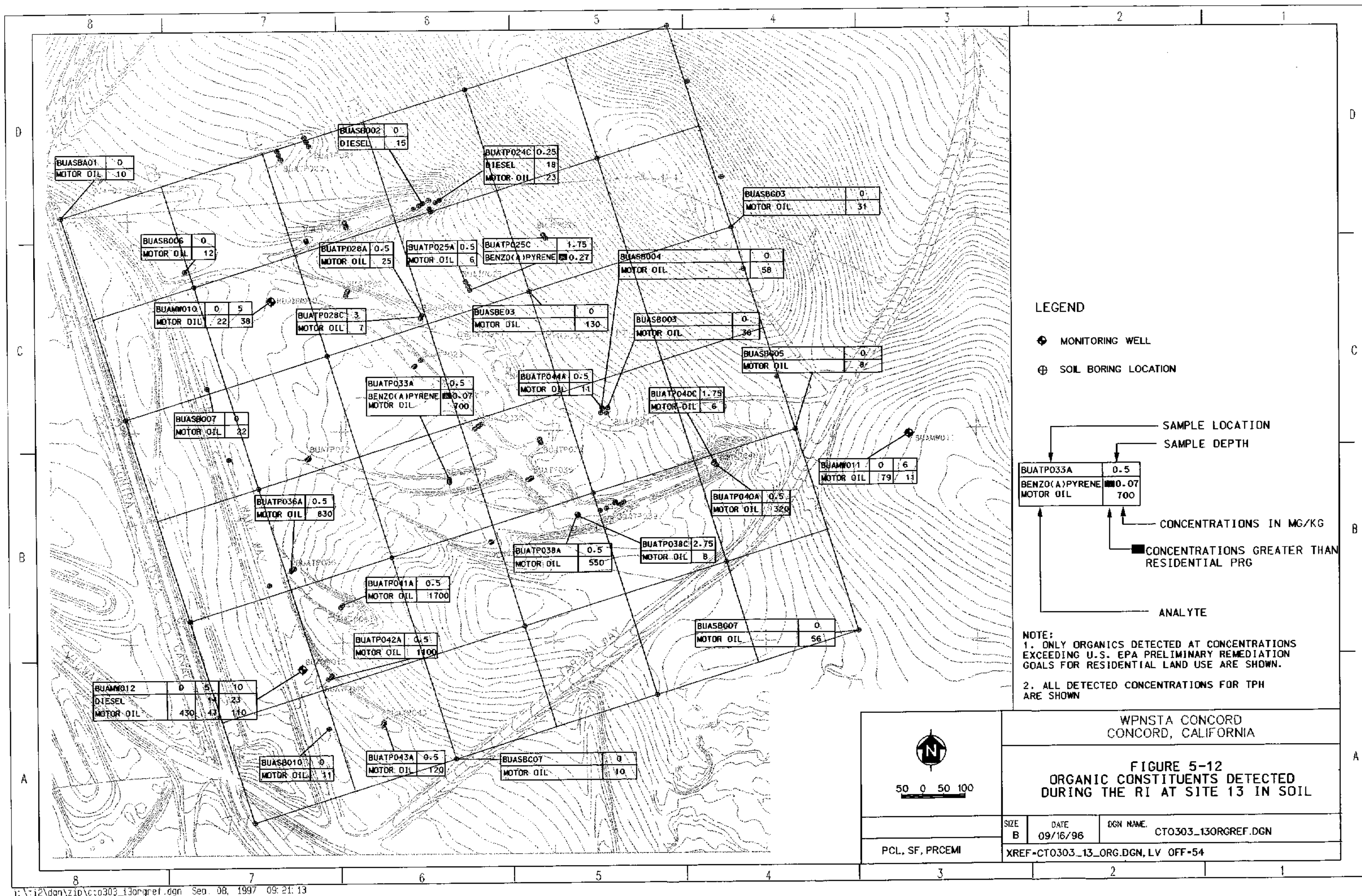
- LEGEND:**
- X FENCE
  - DRAINAGE CHANNEL (WITH ARROW INDICATING FLOW DIRECTION)
  - GROUND SURFACE ELEVATION CONTOUR (FT MSL)
  - PIEZOMETER LOCATION (50-110 FT BGS, INSTALLATION DATA UNKNOWN)
  - UC-2 ⊗ UNOCAL MONITORING WELLS (0-30 FT BGS, INSTALLED BY GTI, 1991)
  - ⊕ MONITORING WELL LOCATION
  - ⊕ SOIL BORING LOCATION
  - SURVEY GRID LOCATION
  - TRENCH PIT ORIENTATION AND LOCATION

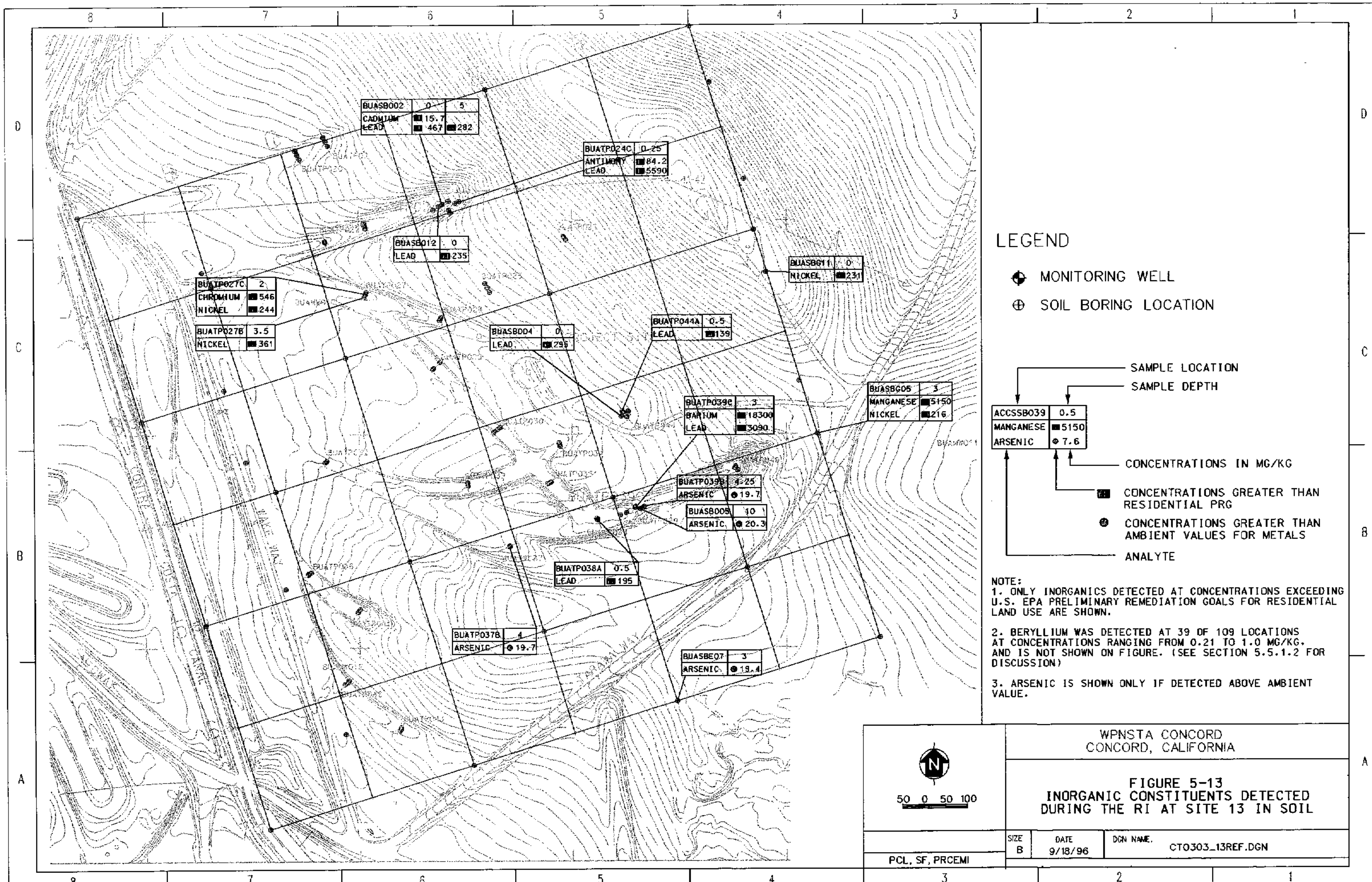
NWS CONCORD - INLAND AREA  
CONCORD, CALIFORNIA

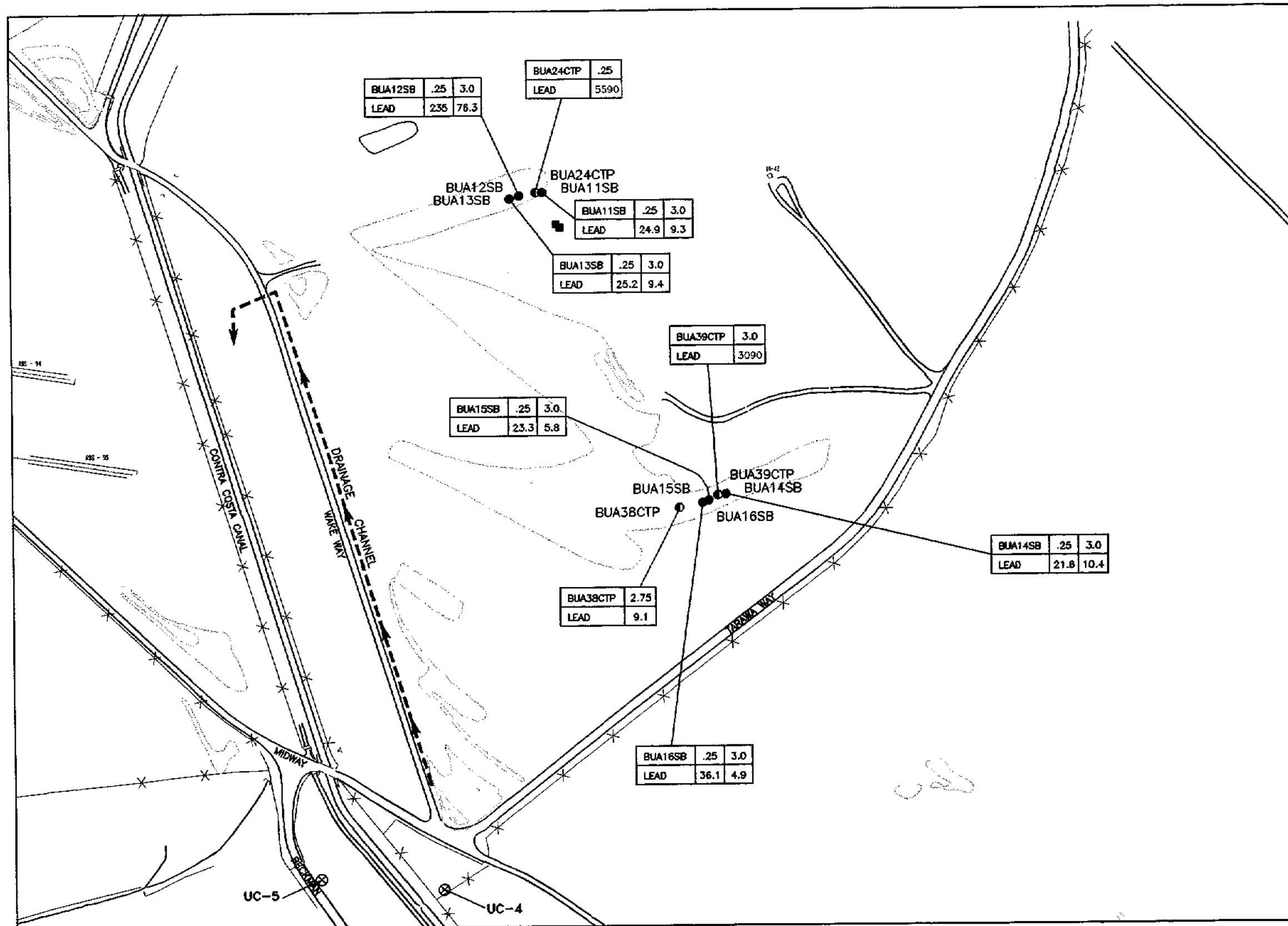
**FIGURE 5-11**  
**SITE 13 - REMEDIAL INVESTIGATION**  
**SAMPLING LOCATIONS**

SIZE	DATE	DWG NAME	REV



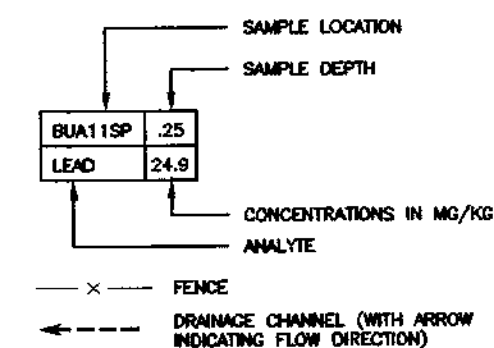






# **LEGEND:**

- SOIL BORING LOCATION (0-3 FT BGS)
- TEST PIT LOCATION (SAMPLES COLLECTED AT 0.25 AND 2.75 FT BGS)
- PIEZOMETER LOCATION (50-110 FT BGS, INSTALLATION DATA UNKNOWN)
- UC-2 ○ UNOCAL MONITORING WELLS (0-30 FT BGS, INSTALLED BY GTI, 1991)



# **NOTES:**

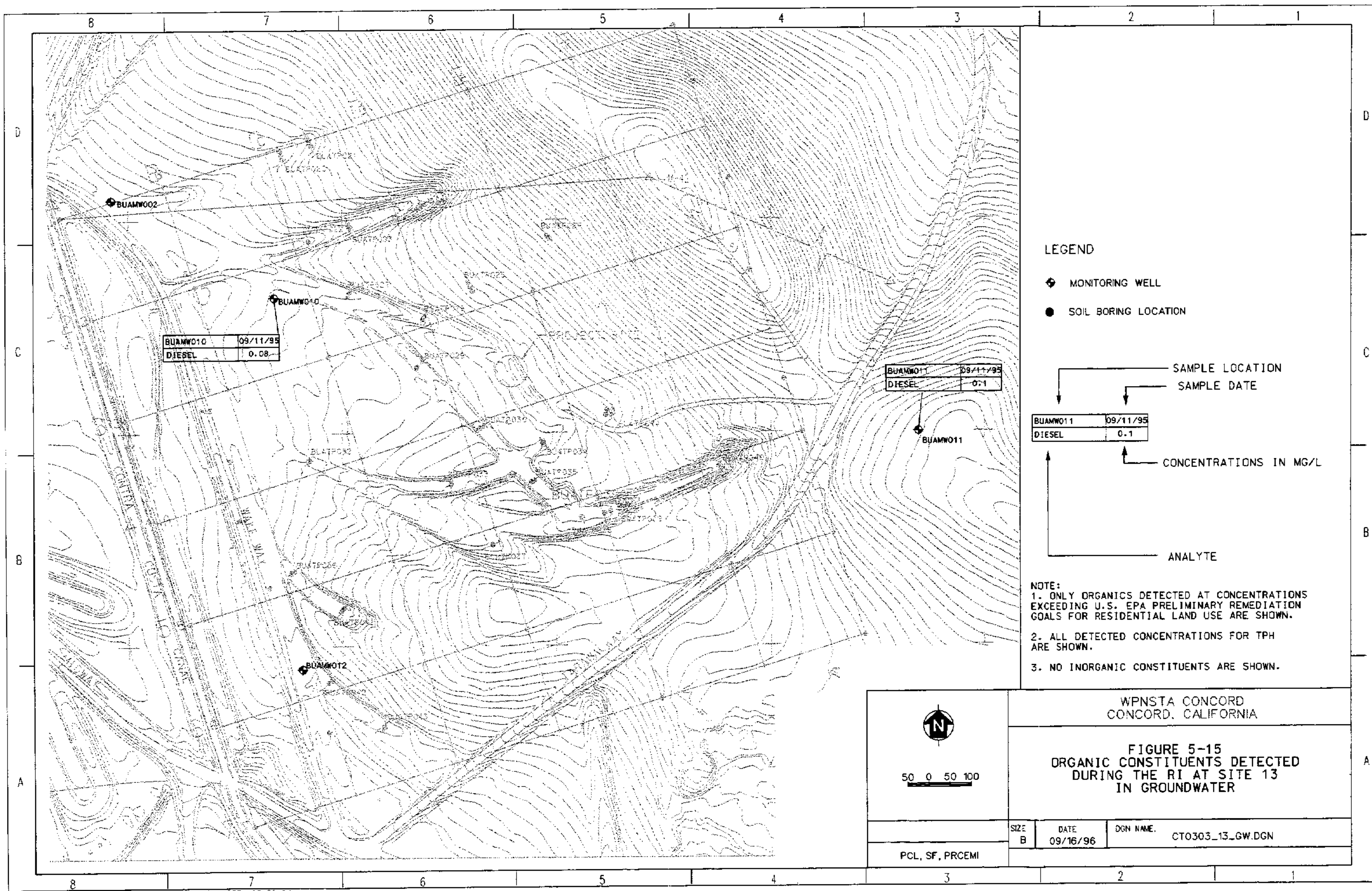
- RED COLOR INDICATES LEAD GREATER THAN TLIC VALUE (1000 mg/kg)

NAVAL WEAPONS STATION CONCORD  
CONCORD, CALIFORNIA

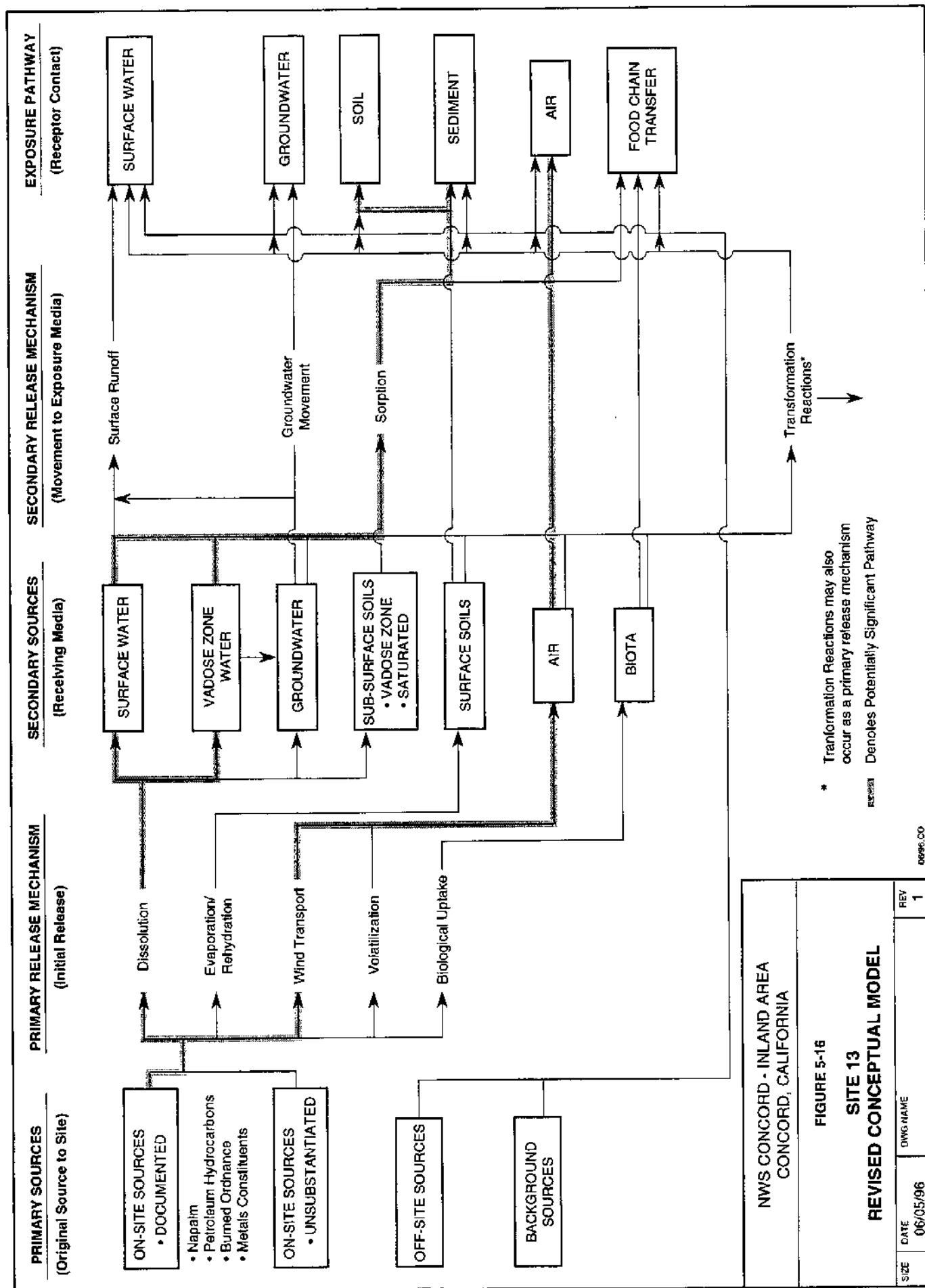
FIGURE 5-14

**SITE 13 - DELINEATION OF  
ELEVATED LEAD CONCENTRATIONS**

SIZE	FROM NO.	CHG NO.	REV
B		LEAD13	2







NW/S CONCORD - INLAND AREA CONCORD, CALIFORNIA			
FIGURE 5-16 SITE 13 REVISED CONCEPTUAL MODEL			
SIZE	DATE	DWG NAME	REV
	06/05/96		1

TABLE 5-1

**REMEDIAL INVESTIGATION  
SUMMARY OF GEOTECHNICAL TESTING RESULTS  
SITE 13 - BURN AREA  
WPNSTA CONCORD**

Laboratory Identification	Soil Sample Location	Sample Interval (feet bgs)	Grain Size	USCS Symbol	Permeability (cm/sec)	Porosity (%)	Density lb/ft <sup>3</sup>	Specific Gravity	Moisture (%)
AS809	BUAMW011	124.0-125.0	Gravel with trace clay	GP-GC	1.50E-01	39.69	102.0	2.71	11.3
AS816	BUAMW010	38.0-39.0	Clayey, gravelly sand	SC	1.00E-07	40.34	99.0	2.66	25.4
UA175	BUASBG05	0.0-1.5	Sandy clay	~	NA	NA	NA	NA	NA
UA176	BUASBG03	0.0-0.5	Sandy clay with some gravel	~	NA	NA	NA	NA	NA
UA177	BUASBG07	0.0-0.5	Sandy clay with some gravel	~	NA	NA	NA	NA	NA
UA178	BUASBE03	0.0-1.5	Sandy clay	~	NA	NA	NA	NA	NA
UA204	BUASBA05	0.0-0.5	Clay with organics and sand	~	NA	NA	NA	NA	NA
UA212	BUASBC03	0.0-1.2	Clay with gravel and organics	~	NA	NA	NA	NA	NA
UA214	BUASBC05	0.0-1.2	Clay with organics and some gravel	~	NA	NA	NA	NA	NA
UA216	BUASBC07	0.0-1.2	Clay with sand	~	NA	NA	NA	NA	NA
UA218	BUASBD06	0.0-1.2	Gravelly, clayey sand	SC	NA	NA	NA	NA	NA
UA224	BUASBE05	0.0-1.2	Clay	~	NA	NA	NA	NA	NA
UA805	BUAMW012	38.0-39.0	Clayey sand	SC	1.00E-07	35.42	110.0	2.73	18.8

NA - Not Analyzed for this Parameter

~ - Information not provided by testing laboratory

**SUMMARY OF SOIL ANALYSES, SITE 13  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

Sample Location	Sample Identification	Matrix	Sample Depth	Organic Compounds				Inorganic Constituents			Other Parameters						
				Dioxins	CLP SVOC	Low Level SVOC	TPH Extractable	VOCs	Hex. Chromium	CLP Metals	WET-DI	Microtox Organic Extract	Geophys. Param.	Grain Size	Percent Moisture	pH	TOC
BUAMW010	303BUASS811	Soil	0 - .5		1		1	1			1					1	
	303BUASS812	Soil	5 - 5.5		1		1	1			1					1	
	303BUASS815	Soil	37 - 37.5														1
	303BUASS816	Soil	38.5 - 39									1					
BUAMW011	303BUASS806	Soil	0 - .5		1		1	1			1					1	
	303BUASS807	Soil	6 - 6.5		1		1	1			1					1	
	303BUASS808	Soil	11 - 11.5		1		1	1									1
	303BUASS810	Soil	117 - 118.5														
BUAMW012	303BUASS809	Soil	124 - 124.5														
	303BUASS801	Soil	0 - .5		1		1	1			1	1				1	
	303BUASS802	Soil	5 - 5.5		1		1	1			1					1	
	303BUASS803	Soil	1 - 10.5		1		1	1			1					1	
BUASB001	303BUASS805	Soil	39 - 4											1	1		1
	303BUASS8073	Soil	.5 - 1.5		1		1	1			1	1				1	
	303BUASS8074	Soil	5 - 6		1		1	1			1					1	
	303BUASS8075	Soil	9 - 1		1		1	1			1					1	
BUASB002	303BUASS8076	Soil	0 - 1		1		1	1			1	1				1	
	303BUASS8077	Soil	5 - 6		1		1	1			1					1	
	303BUASS8078	Soil	1 - 11		1		1	1			1					1	
	303BUASS8079	Soil	0 - 1		1		1	1			1					1	
BUASB003	303BUASS8080	Soil	4.7 - 5.3		1		1	1			1					1	
	303BUASS8081	Soil	0 - 1		1		1	1			1	1				1	
BUASB004	303BUASS8082	Soil	5 - 6		1		1	1			1					1	
	303BUASS8083	Soil	16 - 17		1		1	1			1					1	
BUASB005	303BUASS110	Soil	0 - .5		1		1	1			1					1	
	303BUASS111	Soil	5 - 6		1		1	1			1					1	
	303BUASS112	Soil	1 - 11		1		1	1			1					1	
	303BUASS300	Soil	0 - .5		1		1	1			1					1	
BUASB006	303BUASS301	Soil	0 - .5		1		1	1			1					1	
BUASB007	303BUASS302	Soil	0 - .5		1		1	1			1					1	
BUASB008	303BUASS303	Soil	0 - .5		1		1	1			1					1	
BUASB009	303BUASS304	Soil	0 - .5		1		1	1			1					1	
BUASB010	303BUASS305	Soil	0 - .5		1		1	1			1					1	
BUASB011	303BUASS306	Soil	0 - .25								1						
	303BUASS306	Soil	2.75 - 3								1						

TABLE 5-2

**SUMMARY OF SOIL ANALYSES, SITE 13  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD  
(CONTINUED)**

Sample Location	Sample Identification	Matrix	Sample Depth	Organic Compounds				Inorganic Constituents			Other Parameters						
				Dioxins	CLP SVOC	Low Level SVOC	TPH Extractable	VOCs	Hex. Chromium	CLP Metals	WET-DI	Microtox Organic Extract	Geophys. Param.	Grain Size	Percent Moisture	pH	TOC
BUASB012	035BUASS307	Soil	0 - .25							1							
	035BUASS308	Soil	2.75 - 3							1							
	035BUASS309	Soil	0 - .25							1							
BUASB013	035BUASS310	Soil	2.75 - 3							1							
	035BUASS311	Soil	0 - .25							1							
BUASB014	035BUASS312	Soil	2.75 - 3							1							
	035BUASS313	Soil	0 - .25							1							
	035BUASS314	Soil	2.75 - 3							1							
BUASB016	035BUASS315	Soil	0 - .25							1							
	035BUASS316	Soil	2.75 - 3							1							
	303BUASS200	Soil	0 - .5		1	1	1		1	1	1			1	1	1	1
BUASBA01	303BUASS201	Soil	3 - 4		1				1	1	1				1	1	1
	303BUASS202	Soil	0 - .5			1	1			1					1	1	1
BUASBA03	303BUASS203	Soil	3 - 4		1		1	1		1						1	1
	303BUASS204	Soil	0 - .5			1	1			1			1			1	1
BUASBA05	303BUASS205	Soil	3 - 4		1		1	1		1					1	1	1
	303BUASS206	Soil	0 - 1.2			1	1			1						1	1
BUASBA07	303BUASS207	Soil	3 - 3.5		1		1	1		1						1	1
	303BUASS208	Soil	0 - 1.2			1	1			1					1	1	1
BUASBB02	303BUASS209	Soil	3 - 3.5		1		1	1		1						1	1
	303BUASS210	Soil	0 - 1.2			1	1			1						1	1
BUASBB04	303BUASS211	Soil	3 - 3.5		1		1	1		1						1	1
	303BUASS212	Soil	0 - 1.2			1	1			1			1		1	1	1
BUASBC03	303BUASS213	Soil	3 - 3.5		1		1	1		1						1	1
	303BUASS214	Soil	0 - 1.2			1	1			1			1		1	1	1
BUASBC05	303BUASS215	Soil	3 - 3.5		1		1	1		1						1	1
	303BUASS216	Soil	0 - 1.2			1	1			1			1		1	1	1
BUASBC07	303BUASS217	Soil	3 - 3.5		1		1	1		1					1	1	1
	303BUASS218	Soil	0 - 1.2			1	1		1	1			1		1	1	1
BUASBD06	303BUASS219	Soil	3 - 3.5		1		1	1		1						1	1
	303BUASS220	Soil	0 - .5			1	1			1						1	1
BUASBE01	303BUASS221	Soil	3 - 3.5		1		1	1		1						1	1

TABLE 5-2

**SUMMARY OF SOIL ANALYSES, SITE 13  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD  
(CONTINUED)**

Sample Location	Sample Identification	Matrix	Sample Depth	Organic Compounds				Inorganic Constituents			Other Parameters						
				Dioxins	CLP SVOC	Low Level SVOC	TPH Extractable	VOCs	Hex. Chromium	CLP Metals	WET-DI	Microtox Organic Extract	Geophys. Param.	Grain Size	Percent Moisture	pH	TOC
BUASBE03	303BUASS178	Soil	0 - 1.5			1	1			1		1			1		1
	303BUASS179	Soil	3 - 3.5		1			1									
	303BUASS224	Soil	0 - 1.2			1	1			1		1			1		1
BUASBE05	303BUASS225	Soil	3 - 3.5		1			1									
	303BUASS226	Soil	0 - 1.2			1	1			1					1		
BUASBE07	303BUASS227	Soil	3 - 3.5		1		1	1									
	303BUASS228	Soil	0 - .5			1	1			1					1		1
BUASBP02	303BUASS229	Soil	3 - 3.5		1			1									
	303BUASS230	Soil	0 - .5			1	1			1					1		
	303BUASS231	Soil	3 - 3.5		1			1				1					
BUASBF06	303BUASS231	Soil	3 - 3.5		1			1				1					
	303BUASS001	Soil	.5 - .5		1		1			1							
	303BUASS002	Soil	4 - 4		1			1									
BUATP020A	303BUASS002	Soil	2.5 - 2.5		1			1									
BUATP020B	303BUASS003	Soil	.5 - .5	1	1		1			1					1		
BUATP021A	303BUASS004	Soil	3.5 - 3.5		1			1									
	303BUASS005	Soil	1.5 - 1.5		1			1									
	303BUASS006	Soil	.5 - .5		1			1									
BUATP022A	303BUASS007	Soil	4.5 - 4.5		1		1			1							
BUATP022B	303BUASS008	Soil	1.75 - 1.75		1			1									
BUATP022C	303BUASS009	Soil	.5 - .5	1	1		1		1						1		
BUATP023A	303BUASS010	Soil	3.5 - 3.5		1			1									
	303BUASS011	Soil	1 - 1		1			1									
	303BUASS012	Soil	.5 - .5	1	1			1							1		
BUATP024A	303BUASS070	Soil	3 - 3		1			1									
BUATP024B	303BUASS071	Soil	.25 - .25		1			1									
BUATP024C	303BUASS072	Soil	.5 - .5		1			1									
BUATP025A	303BUASS025	Soil	3 - 3		1			1									
	303BUASS026	Soil	1.75 - 1.75		1			1									
	303BUASS027	Soil	.5 - .5		1			1									
BUATP026A	303BUASS028	Soil	4 - 4		1			1									
BUATP026B	303BUASS029	Soil	3 - 3		1			1									
BUATP026C	303BUASS030	Soil	.5 - .5		1			1									
BUATP027A	303BUASS022	Soil	3.5 - 3.5		1			1									
BUATP027B	303BUASS023	Soil															

TABLE 5-2

**SUMMARY OF SOIL ANALYSES, SITE 13  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD  
(CONTINUED)**

Sample Location	Sample Identification	Matrix	Sample Depth	Organic Compounds				Inorganic Constituents			Other Parameters						
				Dioxins	CLP SVOC	Low Level SVOC	TPH Extractable	VOCs	Hex. Chromium	CLP Metals	WET-DI	Microtox Organic Extract	Geophys. Param.	Grain Size	Percent Moisture	pH	TOC
BUATP027C	303BUASS024	Soil	2 - 2		1		1			1						1	
BUATP028A	303BUASS013	Soil	5 - 5		1		1			1						1	
BUATP028B	303BUASS014	Soil	4 - 4		1		1	1		1						1	
BUATP028C	303BUASS015	Soil	3 - 3		1		1	1		1						1	
BUATP029A	303BUASS019	Soil	5 - 5	1	1		1			1					1	1	
BUATP029B	303BUASS020	Soil	3.5 - 3.5		1		1	1	1							1	
BUATP029C	303BUASS021	Soil	1.5 - 1.5		1		1	1		1						1	
BUATP030A	303BUASS016	Soil	5 - 5		1		1			1						1	
BUATP030B	303BUASS017	Soil	3 - 3		1		1	1		1						1	
BUATP030C	303BUASS018	Soil	1.5 - 1.5		1		1	1	1	1						1	
BUATP032A	303BUASS049	Soil	5 - 5		1		1			1	1					1	
BUATP032B	303BUASS050	Soil	4.5 - 4.5		1		1	1	1	1						1	
BUATP032C	303BUASS051	Soil	2 - 2		1		1	1		1						1	
BUATP033A	303BUASS052	Soil	5 - 5	1	1		1			1						1	
BUATP033B	303BUASS053	Soil	4 - 4		1		1	1		1						1	
BUATP033C	303BUASS054	Soil	2.5 - 2.5		1		1	1		1						1	
BUATP034A	303BUASS064	Soil	5 - 5	1	1		1			1						1	
BUATP034B	303BUASS065	Soil	4 - 4		1		1	1		1						1	
BUATP034C	303BUASS066	Soil	2 - 2		1		1	1		1						1	
BUATP035A	303BUASS058	Soil	5 - 5		1		1			1						1	
BUATP035B	303BUASS059	Soil	4.5 - 4.5		1		1	1		1						1	
BUATP035C	303BUASS060	Soil	1.5 - 1.5		1		1	1	1	1						1	
BUATP036A	303BUASS046	Soil	5 - 5		1		1			1						1	
BUATP036B	303BUASS047	Soil	4 - 4		1		1	1		1						1	
BUATP036C	303BUASS048	Soil	1.75 - 1.75		1		1	1		1						1	
BUATP037A	303BUASS055	Soil	5 - 5		1		1			1	1					1	
BUATP037B	303BUASS056	Soil	4 - 4		1		1	1		1						1	
BUATP037C	303BUASS057	Soil	1.75 - 1.75		1		1	1	1	1						1	
BUATP038A	303BUASS061	Soil	5 - 5		1		1			1						1	
BUATP038B	303BUASS062	Soil	4.5 - 4.5		1		1	1		1						1	
BUATP038C	303BUASS063	Soil	2.75 - 2.75		1		1	1		1						1	
BUATP039A	303BUASS034	Soil	5 - 5		1		1			1						1	
BUATP039B	303BUASS035	Soil	4.25 - 4.25		1		1	1	1	1						1	

TABLE 5-2

**SUMMARY OF SOIL ANALYSES, SITE 13  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD  
(CONTINUED)**

Sample Location	Sample Identification	Matrix	Sample Depth	Organic Compounds					Inorganic Constituents			Other Parameters					
				Dioxins	CLP SVOC	Low Level SVOC	TPH Extractable	VOCs	Hex. Chromium	CLP Metals	WET-DI	Microtox Organic Extract	Geophys. Param.	Grain Size	Percent Moisture	pH	TOC
BUATP039C	303BU/ASS036	Soil	3 - 3	1	1		1	1							1	1	
BUATP040A	303BU/ASS031	Soil	.5 - .5	1	1		1			1	1				1	1	
BUATP040B	303BU/ASS032	Soil	3.75 - 3.75		1		1	1									
BUATP040C	303BU/ASS033	Soil	1.75 - 1.75		1		1	1			1					1	
BUATP041A	303BU/ASS040	Soil	.5 - .5	1	1		1		1	1					1	1	
BUATP041B	303BU/ASS041	Soil	4 - 4		1		1	1								1	
BUATP041C	303BU/ASS042	Soil	2.5 - 2.5		1		1	1			1					1	
BUATP042A	303BU/ASS037	Soil	.5 - .5		1		1				1					1	
BUATP042B	303BU/ASS038	Soil	3.5 - 3.5		1		1	1			1					1	
BUATP042C	303BU/ASS039	Soil	2 - 2		1		1	1								1	
BUATP043A	303BU/ASS043	Soil	.5 - .5		1		1			1	1					1	
BUATP043B	303BU/ASS044	Soil	4 - 4		1		1	1			1					1	
BUATP043C	303BU/ASS045	Soil	4.5 - 4.5		1		1	1			1					1	
BUATP044A	303BU/ASS067	Soil	.5 - .5	1	1		1			1	1				1	1	
BUATP044B	303BU/ASS068	Soil	4 - 4		1		1	1			1					1	
BUATP044C	303BU/ASS069	Soil	2.75 - 2.75		1		1	1			1					1	
Total				10	115	16	129	78	12	143	35	7	3	10	51	131	10

Notes:

Section 3.0 tables list the analytical methods used and Appendix I, Quality Control Summary Report, describes quality assurance samples.

TABLE 5-3

**SUMMARY OF WATER ANALYSES, SITE 13  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

				Organic Compounds							Inorganic Constit.	Other Parameters			
Sample Location	Matrix	Investigation	Sample Date	Aromatic Volatiles	Explos.	CLP SVOC	TPH Extract.	TPH Purge.	VOC	Metals	pH	TSS	TOC	Cond./ Hardness	
BUAMW002	Groundwater	RI	9/11/95			1	1		1	1	1	1	1	1	
	Groundwater	RI	6/9/95			1	1		1	1	1	1	1	1	
BUAMW010	Groundwater	RI	6/13/95			1	1		1	1	1	1	1	1	
	Groundwater	RI	9/11/95			1	1		1	1	1	1	1	1	
BUAMW011	Groundwater	RI	6/14/95				1		1	1	1	1	1	1	
	Groundwater	RI	9/11/95			1	1		1	1	1	1	1	1	
BUAMW012	Groundwater	RI	6/13/95			1	1		1	1	1	1	1	1	
	Groundwater	RI	9/11/95			1	1		1	1	1	1	1	1	
BUAMWU01	Groundwater	RI	6/5/95							1	1	1		1	
	Groundwater	RI	9/12/95							1	1	1	1	1	
BUAMWU02	Groundwater	RI	6/6/95							1	1	1		1	
	Groundwater	RI	9/13/95							1	1	1	1	1	
BUAMWU04	Groundwater	RI	6/6/95							1	1	1		1	
	Groundwater	RI	9/13/95							1	1	1	1	1	
BUAMWU05	Groundwater	RI	6/5/95							1	1	1		1	
	Groundwater	RI	9/12/95							1	1	1	1	1	
Total:				2	2	7	10	2	8	18	18	18	12	18	

**Notes:**

Section 3.0 tables list the analytical methods used and Appendix I, Quality Control Summary Report, describes quality assurance samples.

Explos. - Explosive Compounds

TPH Extract. - Extractable total petroleum hydrocarbons

TPH Purge. - Purgeable total petroleum hydrocarbons

TSS - Total suspended solids

TOC - Total organic carbon



TABLE 5-4

SUMMARY OF DETECTED VOCs IN SOIL  
SITE 13 - BURN AREA  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD

Sample Location	Investigation	Sample Depth (ft bgs)	1,2-Dichloropropane	2-Butanone	4-Methyl-2-pentanone	Acetone	Carbon Disulfide	Chloroform	Toluene	Trichloroethene	Xylene (Total)
Residential PRGs (mg/kg)			0.31	7,100	770	2,100	7.5	0.25	790	3.2	320
Concentration (mg/kg)											
BUASB001	RI	9 - 10	--	--	--	--	--	0.001	--	--	--
BUAMW012	RI	10 - 10.5	--	--	--	--	--	--	--	--	0.006

NE - Not Established

Concentrations shown in **bold** exceed the residential PRG.

Appendix J contains full analytical tables which include the date sampled, samples with nondetected concentrations, and detection limits.

**SUMMARY OF DETECTED SVOCs IN SOIL  
SITE 13 - BURN AREA  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

[illegible]

TABLE 5-5

SUMMARY OF DETECTED SVOCs IN SOIL  
SITE 13 - BURN AREA  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD  
(CONTINUED)

Sample Location	Investigation	Sample Depth (ft bgs)	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Benzoic Acid	Chrysene	Fluoranthene	Phenol	Pyrene	2,4-Dinitrotoluene	2-Chlorophenol	2-Methylnaphthalene	N-Nitrosodiphenylamine	Naphthalene	High Molecular Weight PAHs	Low Molecular Weight PAHs	Total PAHs
Residential PRGs (mg/kg)			0.061	0.61	NE	100,000	6.1	2,600	39,000	100	130	91	NE	91	240	NE	NE	NE
Concentration (mg/kg)																		
BUASBC07	RI	0 - 1.2	--	--	0.021	--	0.015	--	0.16	--	--	--	--	--	--	0.015	--	0.015
		3 - 3.5	--	--	--	--	--	--	0.34	--	--	--	--	--	--	--	--	--
BUASBD06	RI	0 - 1.2	--	--	--	0.016	--	--	--	--	--	--	--	--	--	--	--	--
		3 - 3.5	--	--	--	--	--	--	0.86	--	--	--	--	--	--	--	--	--
BUASBE01	RI	0 - .5	--	--	--	0.021	--	--	0.23	--	--	--	--	--	--	--	--	--
BUASBE03	RI	0 - 1.5	--	--	--	--	--	--	0.59	--	--	--	--	--	--	--	--	--
BUASBE05	RI	0 - 1.2	--	--	--	0.026	--	--	--	--	--	--	--	--	--	--	--	--
		3 - 3.5	--	--	--	--	--	--	0.42	--	--	--	--	--	--	--	--	--
BUASBE07	RI	0 - 1.2	--	--	--	0.02	--	--	--	--	--	--	--	--	--	--	--	--
BUASBF02	RI	0 - .5	--	--	--	0.014	--	--	--	--	--	--	--	--	--	--	--	--
		3 - 3.5	--	--	--	--	--	--	0.24	--	--	0.19	--	--	--	--	--	--
BUASBF06	RI	0 - .5	--	--	--	--	0.017	--	--	--	--	--	--	--	--	0.017	--	0.017
BUATP025C	RI	1.75 - 1.75	<b>0.27</b>	0.45	--	--	0.21	--	--	0.25	--	--	--	--	--	1.18	--	1.18
BUATP033A	RI	.5 - .5	<b>0.07</b>	--	--	--	0.046	0.026	--	0.031	--	--	--	--	--	0.173	--	0.173
BUATP038A	RI	.5 - .5	--	--	--	--	0.043	0.031	--	--	--	--	--	--	--	0.074	--	0.074

NE - Not Established

Concentrations shown in **bold** exceed the residential PRG.

Appendix J contains full analytical tables which include the date sampled, samples with nondetected concentrations, and detection limits.

TABLE 5-6

**SUMMARY OF DETECTED TPH IN SOIL  
SITE 13 - BURN AREA  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

Sample Location	Investigation	Sample Depth (ft bgs)	Diesel	Motor Oil
Residential PRGs (mg/kg)			NE	NE
Concentration (mg/kg)				
BUAMW010	RI	0 - .5	--	22
	RI	5 - 5.5	--	38
BUAMW011	RI	0 - .5	--	79
	RI	6 - 6.5	--	11
BUAMW012	RI	0 - .5	--	430
	RI	5 - 5.5	14	47
	RI	10.0 - 10.5	23	110
BUASB002	RI	0 - 1	15	--
BUASB003	RI	0 - 1	--	38
BUASB004	RI	0 - 1	--	58
BUASB006	RI	0 - .5	--	12
BUASB007	RI	0 - .5	--	22
BUASB010	RI	0 - .5	--	11
BUASBA01	RI	0 - .5	--	10
BUASBC07	RI	0 - 1.2	--	10
BUASBE03	RI	0 - 1.5	--	130
BUATP024C	RI	.25 - .25	18	23
BUATP025A	RI	.5 - .5	--	6
BUATP028A	RI	.5 - .5	--	25
BUATP028C	RI	3 - 3	--	7
BUATP033A	RI	.5 - .5	--	700
BUATP036A	RI	.5 - .5	--	830
BUATP038A	RI	.5 - .5	--	550
BUATP038C	RI	2.75 - 2.75	--	8
BUATP040A	RI	.5 - .5	--	320
BUATP040C	RI	1.75 - 1.75	--	6
BUATP041A	RI	.5 - .5	--	1,700
BUATP042A	RI	.5 - .5	--	1,100
BUATP043A	RI	.5 - .5	--	120
BUATP044A	RI	.5 - .5	--	11

NE - Not Established

TABLE 5-7

**SUMMARY OF DETECTED METALS IN SOIL**  
**SITE 13 - BURN AREA**  
**INLAND AREA REMEDIAL INVESTIGATION**  
**NWS CONCORD**

Sample Location	Investigation	Sample Depth (ft bgs)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Silver	Thallium	Vanadium	Zinc
Residential PRGs (mg/kg)			77,000.00	31.00	0.38	5,300.00	0.14	9.00	77,000.00	4,600.00	2,800.00	130.00	3,200.00	23.00	150.00	380.00	5.40	540.00	23,000.00
Concentrations of Total Metals (mg/kg)																			
BUAMW010	RI	0 - 5	22,400.00	--	5.50	284.00	--	--	44.20	17.60	27.10	17.40	744.00	--	57.50	--	--	61.50	46.50
	RI	5 - 5.5	19,500.00	--	4.90	214.00	--	--	41.10	10.70	25.50	8.70	478.00	--	43.00	--	--	56.70	42.10
BUAMW011	RI	0 - 5	18,400.00	0.68	--	319.00	--	--	61.80	20.20	33.00	13.30	935.00	0.12	55.00	--	--	81.20	54.90
	RI	6 - 6.5	16,500.00	1.00	4.40	226.00	--	--	57.30	20.90	43.40	5.00	743.00	0.12	61.10	--	--	91.40	72.10
	RI	11 - 11.5	16,100.00	0.69	5.30	246.00	--	--	30.90	11.00	30.10	7.30	328.00	0.14	39.80	--	--	44.20	59.10
BUAMW012	RI	0 - 5	12,500.00	0.41	7.30	194.00	--	--	32.80	13.80	33.50	10.60	538.00	0.11	55.80	--	--	46.80	63.10
	RI	5 - 5.5	18,300.00	--	8.70	271.00	--	--	35.90	15.60	34.90	9.60	626.00	0.15	63.80	--	--	64.40	69.40
	RI	10 - 10.5	11,600.00	--	7.10	205.00	--	--	32.20	14.70	37.40	8.30	586.00	0.14	56.90	--	--	46.30	111.00
BUASB001	RI	5 - 6	24,800.00	0.64	9.40	250.00	0.65	--	46.80	16.60	43.90	24.90	748.00	--	63.00	--	--	70.90	--
	RI	9 - 10	20,000.00	0.60	6.70	354.00	0.61	--	38.90	14.30	34.80	7.00	566.00	--	58.00	--	--	59.10	--
	RI	5 - 1.5	22,500.00	0.63	5.50	238.00	0.60	--	52.20	14.50	33.40	12.80	612.00	--	60.90	--	--	66.00	--
BUASB002	RI	0 - 1	28,900.00	8.40	6.70	940.00	0.63	15.70	46.80	16.60	355.00	467.00	1,450.00	--	68.00	1.60	--	68.60	1,340.00
	RI	5 - 6	19,000.00	0.96	5.80	300.00	0.62	--	36.70	16.70	34.70	282.00	737.00	--	57.00	--	--	61.10	--
	RI	10 - 11	19,400.00	--	5.10	256.00	0.63	--	37.90	18.40	31.40	8.90	782.00	--	61.00	--	--	58.10	--
BUASB003	RI	0 - 1	14,300.00	1.20	5.90	807.00	0.42	--	33.60	16.00	55.20	74.00	759.00	0.37	57.60	--	--	56.50	249.00
	RI	4.7 - 5.3	21,000.00	0.57	6.90	1,130.00	0.58	--	43.50	25.90	69.80	19.30	1,190.00	0.35	75.50	--	--	68.20	244.00
BUASB004	RI	0 - 1	15,600.00	0.59	5.30	931.00	0.52	--	36.50	16.60	35.40	295.00	724.00	--	54.40	--	--	57.80	--
	RI	5 - 6	18,100.00	0.42	5.80	560.00	0.54	--	38.60	17.20	56.70	10.60	836.00	2.90	66.70	--	--	60.90	--
	RI	16 - 17	17,400.00	0.66	1.90	97.80	0.55	--	35.80	17.30	48.70	7.20	854.00	0.27	90.60	--	--	47.50	--
BUASB005	RI	0 - 5	17,400.00	--	5.00	486.00	--	--	36.50	16.60	27.90	10.30	654.00	--	52.50	--	--	49.00	38.40
	RI	5 - 6	9,330.00	--	5.40	307.00	--	--	--	18.00	35.70	10.30	262.00	0.11	47.20	--	--	37.70	55.30
	RI	10 - 11	14,700.00	--	20.30	197.00	--	--	39.20	14.00	65.20	12.10	527.00	0.22	95.20	--	--	45.30	97.40
BUASB006	RI	0 - 5	13,800.00	--	4.50	284.00	--	--	33.00	16.20	24.40	15.10	941.00	--	41.80	--	--	44.30	41.20
BUASB007	RI	0 - 5	8,820.00	--	6.10	169.00	--	--	19.50	9.60	21.60	18.20	221.00	0.06	25.40	--	--	31.10	56.50
BUASB008	RI	0 - 5	12,400.00	--	4.00	266.00	0.21	--	22.10	13.00	22.40	12.40	537.00	0.07	36.00	--	--	34.80	249.00
BUASB009	RI	0 - 5	11,100.00	--	5.40	171.00	--	--	26.50	14.50	28.00	16.80	517.00	--	41.40	--	--	42.80	71.10
BUASB010	RI	0 - 5	11,700.00	--	8.00	187.00	--	--	30.40	15.00	34.70	17.10	717.00	0.11	68.60	--	--	37.70	64.30
BUASB011	RI	0 - 25	--	--	--	--	--	--	--	--	--	24.90	--	--	--	--	--	--	--
	RI	2.75 - 3	--	--	--	--	--	--	--	--	--	9.30	--	--	--	--	--	--	--
BUASB012	RI	0 - 25	--	--	--	--	--	--	--	--	--	235.00	--	--	--	--	--	--	--
	RI	2.75 - 3	--	--	--	--	--	--	--	--	--	76.30	--	--	--	--	--	--	--

TABLE 5-7

**SUMMARY OF DETECTED METALS IN SOIL**  
**SITE 13 - BURN AREA**  
**INLAND AREA REMEDIAL INVESTIGATION**  
**NWS CONCORD**  
**(CONTINUED)**

Sample Location	Investigation	Sample Depth (ft bgs)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Silver	Thallium	Vanadium	Zinc
Residential PRCs (mg/kg)			77,000.00	31.00	0.38	5,300.00	0.14	9.00	77,000.00	4,600.00	2,800.00	130.00	3,200.00	23.00	150.00	360.00	5.40	540.00	23,000.00
Concentrations of Total Metals (mg/kg)																			
BUASB013	RI	0 - .25										25.20							
	RI	2.75 - 3										9.40							
BUASB014	RI	0 - .25										21.60							
	RI	2.75 - 3										10.40							
BUASB015	RI	0 - .25										23.30							
	RI	2.75 - 3										5.80							
BUASB016	RI	0 - .25										36.10							
	RI	2.75 - 3										4.90							
BUASBA01	RI	0 - .5	6,660.00		2.40	103.00			20.90	11.70	11.40	6.80	447.00		14.30			38.30	13.40
	RI	3 - 4	9,120.00		2.30	203.00			20.70	10.90	11.70	7.30	432.00		21.50			37.40	13.40
BUASBA03	RI	0 - .5	16,700.00		5.20	346.00			26.30	11.60	23.50	10.80	552.00		40.20			45.20	40.70
	RI	3 - 4	14,800.00		4.20	439.00		0.42	22.20	12.00	22.10	8.30	619.00		39.50			43.40	38.60
BUASBA05	RI	0 - .5	11,100.00		2.80	567.00			28.60	15.00	19.70	6.30	567.00		68.60			49.80	20.80
	RI	3 - 4	9,010.00		3.50	207.00			30.00	11.70	14.10	6.00	437.00		56.50			48.10	24.70
BUASBA07	RI	0 - 1.2	16,600.00		5.90	644.00				12.60	22.60	8.70	571.00		39.70			51.60	45.00
	RI	3 - 3.5	18,700.00		5.60	176.00		0.72	48.20	18.20	47.00	7.80	629.00	0.10	76.40			75.30	65.40
BUASBB02	RI	0 - 1.2	11,900		2.90	257.00				10.50	33.50	7.80	350.00		38.40			27.90	61.80
	RI	3 - 3.5	12,100.00		4.50	131.00				12.20	21.20	11.30	615.00		39.00			34.40	27.80
BUASBB04	RI	0 - 1.2	12,000.00		3.80	142.00			31.80	15.00	22.40	7.90	552.00	0.08	40.60			42.40	27.20
	RI	3 - 3.5	12,000.00		2.80	320.00			20.30	7.30	19.10	6.70	176.00	0.08	27.10			29.60	40.30
BUASBC03	RI	0 - 1.2	11,300.00		8.60	195.00			26.60	22.00	39.40	8.10	650.00	0.08	62.10			31.30	63.40
	RI	3 - 3.5	8,050.00		2.70	113.00			19.20	13.60	15.30	6.70	680.00		27.60			32.50	17.40
BUASBC05	RI	0 - 1.2	7,880.00		4.80	268.00			18.00	11.00	20.50	7.00	318.00	0.06	32.90			28.40	22.80
	RI	3 - 3.5	11,700.00		6.60	63.00				14.00	38.70	9.30	357.00	0.08	60.30			39.40	60.80
BUASBC07	RI	0 - 1.2	13,300.00		5.90	257.00		0.52	27.70	15.00	29.30	11.80	635.00	0.06	50.60			48.80	48.50
	RI	3 - 3.5	11,300.00		5.10	305.00		0.46	27.80	17.20	25.30	8.50	700.00		50.70			47.30	41.70
BUASBD06	RI	0 - 1.2	7,890.00		1.70	112.00			21.70	8.80	21.30	4.50	374.00	0.16	42.50			26.60	27.90
	RI	3 - 3.5	12,000.00		7.00	111.00			27.00	4.70	36.50	7.40	89.90		32.00			43.80	58.60
BUASBE01	RI	0 - .5	14,400.00	0.47	3.40	250.00			42.10	17.50	35.70		788.00		67.20			65.20	
	RI	3 - 3.5	16,100.00		3.60	223.00			48.70	20.00	40.40		1030.00		78.90			67.10	58.90

TABLE 5-7

**SUMMARY OF DETECTED METALS IN SOIL**  
**SITE 13 - BURN AREA**  
**INLAND AREA REMEDIAL INVESTIGATION**  
**NWS CONCORD**  
**(CONTINUED)**

Sample Location	Investigation	Sample Depth (ft bgs)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Silver	Thallium	Vanadium	Zinc
Residential PRGs (mg/kg)			77,000.00	31.00	0.38	5,300.00	0.14	9.00	77,000.00	4,600.00	2,800.00	130.00	3,200.00	23.00	150.00	380.00	5.40	540.00	23,000.00
Concentrations of Total Metals (mg/kg)																			
BUASBE03	RI	0 - 1.5	11,200.00	--	4.10	217.00	--	--	27.90	16.60	28.60	20.90	682.00	--	46.90	--	--	45.40	99.10
	RI	3 - 3.5	12,200.00	--	4.00	314.00	--	--	30.10	16.80	28.00	--	794.00	--	54.20	--	--	48.10	--
BUASBE05	RI	0 - 1.2	10,300.00	--	2.90	329.00	--	--	21.90	13.70	22.40	7.40	488.00	--	35.60	--	--	34.10	25.40
	RI	3 - 3.5	9,730.00	--	3.00	640.00	--	--	22.20	11.00	22.60	6.70	372.00	--	37.60	--	--	31.60	32.60
BUASBE07	RI	0 - 1.2	7,120.00	--	2.20	142.00	--	0.24	22.50	7.90	19.10	5.00	272.00	0.06	35.80	--	--	31.50	22.00
	RI	3 - 3.5	7,250.00	--	19.40	254.00	--	--	--	4.50	19.50	6.50	128.00	0.17	17.10	--	--	43.00	32.10
BUASBP02	RI	0 - .5	19,700.00	--	4.00	200.00	--	--	49.30	12.30	29.50	--	486.00	0.09	51.80	--	--	86.00	--
	RI	3 - 3.5	19,300.00	--	8.60	140.00	--	--	65.70	17.40	77.30	--	475.00	0.14	67.90	--	--	131.00	98.40
BUASBF06	RI	0 - .5	15,900.00	--	3.30	237.00	--	--	40.30	13.50	26.50	--	521.00	--	53.60	--	--	65.50	54.70
	RI	3 - 3.5	16,200.00	--	3.30	300.00	--	--	48.00	21.50	34.20	--	994.00	0.08	60.90	--	--	83.40	59.40
BUATP020A	RI	.5 - .5	12,800.00	--	5.60	644.00	--	--	30.60	15.40	27.70	9.00	856.00	--	60.30	--	0.52	45.70	42.80
BUATP020B	RI	.4 - .4	4,660.00	--	--	95.10	--	--	9.50	6.20	13.00	4.20	241.00	--	20.80	--	--	17.70	16.50
BUATP020C	RI	2.5 - 2.5	11,700.00	--	3.30	223.00	--	--	24.70	13.10	21.10	7.30	639.00	0.08	45.00	--	0.39	37.80	41.40
BUATP021A	RI	.5 - .5	12,700.00	--	5.70	228.00	--	--	37.30	18.30	35.20	8.20	739.00	0.10	98.00	--	0.58	54.80	66.90
BUATP021B	RI	3.5 - 3.5	15,000.00	--	3.80	232.00	--	--	28.60	14.00	26.10	9.50	704.00	--	47.20	--	--	37.30	35.90
BUATP021C	RI	1.5 - 1.5	11,500.00	--	3.40	316.00	--	--	23.10	15.50	23.50	8.40	728.00	--	46.80	--	0.43	33.20	33.20
BUATP022A	RI	.5 - .5	13,300.00	0.46	3.40	364.00	--	--	32.50	19.20	25.70	9.40	1,040.00	--	62.70	--	1.10	48.10	32.20
BUATP022B	RI	4.5 - 4.5	10,100.00	0.73	4.90	158.00	--	--	19.00	8.70	40.70	9.50	149.00	0.08	29.00	--	--	38.80	57.00
BUATP022C	RI	1.75 - 1.75	15,400.00	--	5.10	269.00	--	--	41.00	17.90	27.50	10.40	761.00	--	64.60	--	--	60.70	39.80
BUATP023A	RI	.5 - .5	10,500.00	--	3.80	272.00	--	--	20.30	12.00	22.20	12.20	559.00	--	36.50	--	--	34.70	34.60
BUATP023B	RI	3.5 - 3.5	9,810.00	--	3.20	191.00	--	--	20.00	12.20	19.80	11.40	554.00	--	34.20	--	--	31.20	27.50
BUATP023C	RI	1 - 1	11,100.00	--	3.30	381.00	0.30	--	20.30	17.60	20.70	10.20	1,350.00	--	58.70	--	1.30	35.20	30.80
BUATP024A	RI	.5 - .5	19,300.00	1.70	--	473.00	0.30	1.70	37.90	17.80	48.60	44.20	892.00	--	63.40	0.12	--	50.30	130.00
BUATP024B	RI	3 - 3	18,200.00	--	--	335.00	--	0.80	37.30	18.40	56.20	30.20	731.00	0.08	56.60	--	--	52.30	86.80
BUATP024C	RI	.25 - .25	12,100.00	84.20	--	212.00	0.32	2.10	24.10	12.30	385.00	5,590.00	1,890.00	--	38.10	1.20	2.50	32.80	4,570.00
BUATP025A	RI	.5 - .5	9,810.00	--	3.70	171.00	--	--	28.20	18.70	42.90	46.40	638.00	--	48.00	--	--	64.80	57.60
BUATP025B	RI	3 - 3	9,440.00	--	3.30	235.00	0.29	--	22.30	17.50	23.50	7.60	883.00	--	55.20	--	--	38.60	28.80
BUATP025C	RI	1.75 - 1.75	13,400.00	--	4.20	292.00	0.32	--	30.50	20.60	27.90	11.20	872.00	--	53.90	--	--	43.50	38.80
BUATP026A	RI	.5 - .5	15,600.00	--	3.80	193.00	0.35	--	33.10	19.70	29.20	8.90	1,440.00	--	69.20	--	--	43.40	45.30
BUATP026B	RI	4 - 4	11,000.00	--	2.60	177.00	0.29	--	26.20	15.40	24.50	7.60	700.00	--	51.60	--	--	37.50	36.50
BUATP026C	RI	3 - 3	21,900.00	0.83	4.40	246.00	--	--	43.70	19.20	32.90	8.80	743.00	--	69.00	--	--	61.20	54.30

**SUMMARY OF DETECTED METALS IN SOIL**  
**SITE 13 - BURN AREA**  
**INLAND AREA REMEDIAL INVESTIGATION**  
**NWS CONCORD**  
**(CONTINUED)**

Sample Location	Investigation	Sample Depth (ft bgs)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Silver	Thallium	Vanadium	Zinc
Residential PRCs (mg/kg)			77,000.00	31.00	0.38	5,300.00	0.14	9.00	77,000.00	4,600.00	2,800.00	130.00	3,200.00	23.00	150.00	380.00	5.40	540.00	23,000.00
Concentrations of Total Metals (mg/kg)																			
BUATP027A	RI	5 - 5	10,900.00	0.56	8.70	312.00	--	--	32.00	12.70	30.20	22.20	615.00	0.06	64.00	--	--	43.80	52.70
BUATP027B	RI	3.5 - 3.5	16,500.00	0.55	7.30	129.00	--	--	94.30	40.50	61.70	7.90	3090.00	0.06	361.00	--	--	93.60	88.50
BUATP027C	RI	2 - 2	15,900.00	--	8.40	223.00	--	--	546.00	16.90	82.00	12.20	294.00	0.18	244.00	--	--	112.00	66.70
BUATP028A	RI	5 - 5	12,800.00	--	4.20	316.00	0.34	--	24.30	15.40	26.40	10.30	706.00	--	46.00	--	--	27.50	50.00
BUATP028B	RI	4 - 4	10,700.00	--	4.30	354.00	0.28	--	23.00	12.60	23.60	8.70	622.00	--	42.00	--	--	33.00	34.70
BUATP028C	RI	3 - 3	9,620.00	0.48	3.10	164.00	--	--	22.70	12.20	20.10	8.70	539.00	0.14	31.60	0.52	0.52	35.70	31.70
BUATP029A	RI	5 - 5	11,500.00	--	3.60	274.00	--	--	22.40	14.90	20.90	24.00	703.00	--	38.70	--	--	38.90	37.80
BUATP029B	RI	3.5 - 3.5	17,000.00	--	6.10	147.00	0.42	--	29.60	34.00	35.90	12.20	1480.00	--	92.40	--	1.20	41.20	69.30
BUATP029C	RI	1.5 - 1.5	11,400.00	--	3.70	174.00	--	--	32.30	15.90	16.40	7.80	726.00	--	37.40	--	--	49.30	32.80
BUATP030A	RI	5 - 5	16,200.00	--	4.70	319.00	0.25	0.31	30.60	14.70	32.20	33.00	522.00	0.07	44.00	--	--	48.20	65.60
BUATP030B	RI	3 - 3	9,280.00	--	--	539.00	--	--	17.30	5.30	23.60	9.80	69.40	0.07	17.40	--	--	21.60	41.20
BUATP030C	RI	1.5 - 1.5	6,540.00	--	3.20	76.30	--	--	18.40	9.60	16.20	6.30	197.00	0.06	27.40	--	--	22.70	34.00
BUATP032A	RI	5 - 5	18,200.00	0.64	5.60	342.00	0.60	--	38.00	16.40	35.00	8.60	685.00	--	61.30	--	--	61.90	50.20
BUATP032B	RI	4.5 - 4.5	10,700.00	--	1.60	263.00	0.28	--	16.80	2.20	9.10	7.20	51.90	--	8.00	--	--	22.70	28.60
BUATP032C	RI	2 - 2	20,600.00	0.37	6.10	294.00	0.65	--	31.70	13.20	26.00	7.00	684.00	--	41.90	--	--	48.20	54.70
BUATP033A	RI	5 - 5	17,300.00	1.30	5.10	151.00	0.28	0.41	66.40	17.80	53.30	53.80	556.00	0.17	89.10	--	--	64.30	121.00
BUATP033B	RI	4 - 4	20,800.00	--	11.60	52.20	0.64	--	49.60	16.40	51.70	7.10	393.00	0.21	78.60	--	--	53.50	92.50
BUATP033C	RI	2.5 - 2.5	18,600.00	1.00	9.60	514.00	0.62	--	39.60	25.30	56.30	8.50	403.00	0.12	85.10	--	--	51.60	92.90
BUATP034A	RI	5 - 5	15,000.00	--	--	288.00	--	--	51.30	20.10	51.00	5.00	807.00	0.08	68.30	--	--	69.80	69.40
BUATP034B	RI	4 - 4	12,500.00	--	--	163.00	0.26	--	29.20	11.80	23.30	10.20	469.00	--	58.70	--	--	41.10	



TABLE 5-7

**SUMMARY OF DETECTED METALS IN SOIL**  
**SITE 13 - BURN AREA**  
**INLAND AREA REMEDIAL INVESTIGATION**  
**NWS CONCORD**  
**(CONTINUED)**

Sample Location	Investigation	Sample Depth (ft bgs)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Silver	Thallium	Vanadium	Zinc
Residential PRGs (mg/kg)			77,000.00	31.00	0.38	5,300.00	0.14	9.00	77,000.00	4,600.00	2,800.00	130.00	3,200.00	23.00	150.00	380.00	5.40	540.00	23,000.00
Concentrations of Total Metals (mg/kg)																			
BUATP038B	RI	4.5 - 4.5	15,400.00	0.81	4.80	170.00	0.24	--	66.00	11.20	34.90	5.60	337.00	0.10	56.30	--	--	97.50	67.80
BUATP038C	RI	2.75 - 2.75	12,600.00	0.40	5.90	223.00	0.48	--	28.80	16.30	34.40	9.10	778.00	0.12	61.00	--	--	42.90	50.60
BUATP039A	RI	.5 - .5	15,300.00	--	4.50	592.00	0.34	--	31.90	14.20	31.30	12.10	516.00	--	49.40	--	--	41.30	45.60
BUATP039B	RI	4.25 - 4.25	9,770.00	--	19.70	257.00	--	--	21.60	4.20	55.20	12.30	59.00	0.15	13.50	--	--	24.70	42.30
BUATP039C	RI	3 - 3	54,800.00	13.80	--	18,300.00	--	0.55	--	7.40	60.10	3,090.00	158.00	--	--	0.57	--	15.60	221.00
BUATP040A	RI	.5 - .5	18,900.00	0.92	5.80	168.00	--	--	64.60	19.10	55.80	43.90	813.00	0.13	95.30	--	--	69.40	104.00
BUATP040B	RI	3.75 - 3.75	13,000.00	--	5.00	287.00	0.26	--	30.30	12.60	28.20	8.70	648.00	--	52.20	--	--	49.90	49.50
BUATP040C	RI	1.75 - 1.75	14,800.00	--	5.60	514.00	--	--	32.70	9.50	27.10	9.40	239.00	0.06	33.90	--	--	53.00	50.70
BUATP041A	RI	.5 - .5	13,200.00	1.10	4.20	161.00	--	0.43	41.30	13.50	50.60	31.90	645.00	0.07	62.70	--	--	53.10	132.00
BUATP041B	RI	4 - 4	15,600.00	--	--	66.30	0.28	--	35.20	8.90	40.10	6.20	118.00	0.12	80.90	--	--	36.60	82.20
BUATP041C	RI	2.5 - 2.5	11,200.00	--	--	190.00	--	--	35.60	17.10	31.60	6.60	633.00	--	90.20	--	--	55.10	52.30
BUATP042A	RI	.5 - .5	16,500.00	0.70	4.50	103.00	--	--	75.90	19.80	55.80	41.90	541.00	0.35	125.00	--	--	67.60	130.00
BUATP042B	RI	3.5 - 3.5	13,200.00	0.59	5.90	180.00	--	--	50.70	13.20	32.90	5.00	559.00	0.09	79.20	--	--	67.50	66.80
BUATP042C	RI	2 - 2	11,300.00	0.53	6.70	187.00	--	--	37.40	19.10	31.60	7.00	840.00	0.11	76.80	--	--	69.10	63.20
BUATP043A	RI	.5 - .5	32,000.00	0.88	--	302.00	--	0.37	77.90	24.70	80.60	33.60	930.00	0.08	116.00	--	--	91.70	140.00
BUATP043B	RI	4 - 4	10,800.00	0.56	--	355.00	--	--	51.20	31.30	40.20	6.30	870.00	0.14	117.00	--	--	58.70	62.10
BUATP043C	RI	4.5 - 4.5	8,950.00	--	--	245.00	--	--	23.90	16.50	23.40	7.30	716.00	0.11	67.90	--	--	46.80	47.70
BUATP044A	RI	.5 - .5	16,500.00	1.40	--	1,670.00	--	0.83	34.20	19.20	73.50	139.00	764.00	0.32	53.40	--	--	64.20	502.00
BUATP044B	RI	4 - 4	13,500.00	--	--	494.00	--	2.60	30.00	15.00	41.10	28.30	663.00	0.26	53.30	--	--	44.70	101.00
BUATP044C	RI	2.75 - 2.75	17,500.00	0.58	--	322.00	--	--	37.10	19.70	48.40	12.70	572.00	--	45.50	--	--	51.30	168.00

Concentrations shown in **bold** exceed the residential PRG

Concentrations of calcium, iron, magnesium, potassium, and sodium are not shown because they are common soil minerals, do not have PRGs, and are not expected to be the result of site activities. Appendix J includes a complete listing of the metals results.

TABLE 5-8

**SUMMARY OF DETECTED ORGANICS IN GROUNDWATER  
SITE 13 - BURN AREA  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

Sample Location	Investigation	4-Methylphenol 9/95 (µg/L)	TPH - Diesel 9/95 (mg/L)
Tap Water PRGs (µg/L)		180	NE
BUAMW002	RI	--	--
BUAMW010	RI	6.00	0.08
BUAMW011	RI	--	0.12
BUAMW012	RI	--	--
BUAMWU01	RI	--	--
BUAMWU02	RI	--	--
BUAMWU04	RI	--	--
BUAMWU05	RI	--	--

NE - Not Established

Appendix J contains full analytical tables which include the date sampled, samples with nondetected concentrations, and detection limits.

TABLE 5-9

SUMMARY OF DETECTED METALS IN GROUNDWATER  
SITE 13 - BURN AREA  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD

Sample Location	Investigation	Aluminum 6/95	Aluminum 9/95	Barium 6/95	Barium 9/95	Chromium 6/95	Chromium 9/95	Lead 6/95	Lead 9/95	Manganese 6/95	Manganese 9/95	Molybdenum 6/95	Molybdenum 9/95	Selenium 6/95	Selenium 9/95	Thallium 6/95	Thallium 9/95	Vanadium 6/95	Vanadium 9/95
Tap Water PRGs (µg/L)		37,000	37,000	2,600	2,600	37,000	37,000	4	4	1,700	1,700	180	180	180	180	2.9	2.9	260	260
BUAMW002	RI	--	--	36	--	--	--	--	--	--	--	2	--	8	--	--	--	4	--
BUAMW010	RI	330	--	299	262	--	--	--	--	1,210	<b>3,130</b>	97	28	13	--	2	--	2	--
BUAMW011	RI	190	--	140	121	--	--	--	--	108	492	77	9	15	--	--	--	1	1
BUAMW012	RI	575	--	145	137	23	--	--	--	9	21	2	--	--	--	2	--	6	7
BUAMWU01	RI	--	--	73	73	--	--	--	--	--	--	--	--	--	--	--	--	11	12
BUAMWU02	RI	530	849	104	111	--	--	1	--	28	--	--	--	--	--	--	--	9	10
BUAMWU04	RI	--	--	106	94	--	--	--	--	11	--	--	--	--	--	--	--	9	9
BUAMWU05	RI	--	--	67	63	--	--	1	--	11	--	--	--	--	--	--	--	8	9

Concentrations shown in **bold** exceed the tap water PRG

Concentrations of calcium, iron, magnesium, potassium, and sodium are not shown because they are common soil minerals, do not have PRGs, and are not expected to be the result of site activities. Appendix J includes a complete listing of the metals results.

## **6.0 RESULTS OF THE RI AT BUILDING IA-24 (SITE 17)**

This section presents the results of the RI at Building IA-24 (Site 17). Building IA-24 houses the forklift maintenance and forklift battery maintenance facility. The site included a reported battery acid disposal sump, a steam cleaning pad with a discharge line in nearby Seal Creek, and two USTs. The objective of the RI at Site 17 is to evaluate the nature and extent of chemicals present in groundwater, soil, and sediment as a result of past forklift maintenance activities and use of the USTs.

### **6.1 PHYSICAL DESCRIPTION AND PAST OPERATIONS**

Building IA-24 is located along the eastern side of Kinne Boulevard, approximately 3 miles from the front gate (Figure 1-3). Forklift maintenance operations and forklift battery recharge facilities are located in Building IA-24 and adjacent storage sheds, Buildings IA-24A and IA-24B (Figure 6-1). An asphalt parking lot for forklifts is located along the southeast wall of Building IA-24. There are differing accounts of an earthen battery acid disposal sump that was reportedly present in the area. There is no official documentation on the existence or use of the acid sump. Ecology and Environment reported in the IAS that a sump that existed near Building IA-24 and received forklift battery acid waste for at least 20 years prior to 1974. Forklift batteries were processed for disposal at a rate of one per day. Acid from these batteries was reportedly disposed into the earthen sump at a rate of 20 gallons per day (E&E 1983). IT Corp. later reported that the acid was disposed in the sump at a rate of 20 gallons per year, which seems a more reasonable quantity based on the number of forklifts serviced. The IAS reported the location of the sump to be the southeast corner of Building IA-24. The information presented in the IAS was based on interviews with station personnel. The earthen sump was reportedly backfilled in 1974 and its exact location is unknown (IT Corp. 1989). Numerous soil sampling locations have been investigated near the suspected locations of the acid sump. Despite the excavation of 3 trenches, drilling of 28 soil borings, and analysis of 58 soil samples and 11 groundwater samples, there is no evidence of a sump in the area of the reported activity.

As part of forklift maintenance, the forklifts and batteries were steam cleaned to remove oil and grease. The steam cleaner formerly discharged condensate, oil, and grease through a pipeline from the southwest

side of Building IA-24 and into Seal Creek (Figure 6-1); however, the steam cleaner has not been used since 1988.

In addition, NWS Concord personnel park 3-ton trucks on the unpaved areas between Buildings IA-24 and IA-55. A 1,000-gallon diesel UST is located near the northwest corner of Building IA-55 and a 2,000-gallon diesel UST was located west of Building IA-24 (Figure 6-1). In 1987, shallow vadose-zone wells were installed adjacent to the USTs to monitor vadose zone vapors in the vicinity of each tank. A faint diesel odor was reported from the surface down to 5 feet while drilling the Building IA-55 vadose-zone well in December 1987 (ERM-West 1989). A petroleum odor was reported between depths of 4 feet to 8 feet bgs while drilling the Building IA-24 vadose-zone well in December 1987 (ERM-West 1989). The integrity of each tank was checked by precision testing in January 1988 and annually thereafter. The Building IA-55 tank passed the test; however, the Building IA-24 tank did not and was replaced by an aboveground tank.

## **6.2 PHYSICAL CHARACTERISTICS**

The following section presents the physical setting, geology, hydrogeology, and ecology for Site 17.

### **6.2.1 Physical Setting**

Site 17 is located along the eastern side of Kinne Boulevard approximately 3 miles from the NWS Concord front gate (Figure 1-3). Building IA-24 is the northernmost building in a cluster of five buildings in the immediate area (Figure 6-1). The site is situated on the gently sloping floodplain of Seal Creek, which flows north through a gully 300 feet west of Building IA-24. One thousand feet to the north and east of the site are Los Medanos Hills. A railroad line runs parallel to Kinne Boulevard between the site and Seal Creek. Surface water at the site is collected in a drainage channel that flows to the north of the site, parallel to Kinne Boulevard. The channel passes through a culvert under Kinne Boulevard and under the railroad bed, discharging into Seal Creek west of the north end of Building IA-24 (Figure 6-1). Drainage channels on either side of the railroad bed also transport water northward for discharge into Seal Creek.

### **6.2.2**

### **Geology**

Site 17 is located on the floor of the valley of Mt. Diablo Creek in the central part of the weapons station near the intersection of Kinne Boulevard and O Street. Existing geologic mapping by Dibblee (1980a, 1981) shows that the site is underlain by the alluvium of Mt. Diablo Creek. Boring logs show that the alluvium consists of interbedded clay, silt, sand and gravel to a depth of at least 40 feet below the ground surface (Appendix B). The transects of two cross sections constructed from the boring logs are shown on Figure 6-2. These cross sections (Figures 6-3 and 6-4) show that above an elevation of approximately 130 feet, the alluvium consists primarily of clay and silt with thin, discontinuous interbeds of sand and gravel. Below the 130-foot elevation, the alluvium is composed primarily of sand and gravel. The sand/gravel unit is present in every well that extends below an elevation of 130 feet, and is apparently laterally continuous beneath the site. Maximum observed thickness of the lower sand/gravel unit is approximately 18 feet in well ACS-06-MWA.

### **6.2.3**

### **Hydrogeology**

Hydrogeologic information for Site 17 was collected from monitoring wells ACSMW010 through ACSMW014, installed in May 1995. Groundwater was first encountered in these borings in sands and gravels at approximately 27 to 34 feet bgs. The sands and gravels appear to correspond to the sand/gravel water-bearing unit observed at Site 13. After well construction, water levels rose approximately 1 to 5 feet in each boring, often reaching elevations of overlying silty-clayey soil, indicating potentially semiconfined conditions (Figures 6-3 and 6-4). Based on static water levels, the elevation of the potentiometric surface beneath the Site 17 ranges in elevation from approximately 124 to 130 feet above msl.

Groundwater contours interpreted from data obtained between May 25 and May 31, 1995 are shown on Figure 6-5. May 1995 groundwater elevations ranged from about 124 to 130 ft above msl. Groundwater contours from data collected between September 6 and September 8, 1995 are shown on Figure 6-6. September 1995 groundwater elevations ranged from about 122 to 128 ft above msl. Groundwater flow direction in May and September 1995 was northwesterly in a generally down-valley direction with a gradient of 0.012 ft/ft. Groundwater measurements for the May and September 1995 gauging/sampling events are included in Appendix E.

Vertical permeability of the lower sand/gravel unit was assessed using geotechnical samples collected during this RI. Calculated permeabilities range from 4.00E-04 cm/sec to 6.00E-02 cm/sec. The geotechnical laboratory reports are presented in Appendix D. A summary of geotechnical results for Site 17 is presented in Table 6-1.

### 6.3 RESULTS OF PREVIOUS INVESTIGATIONS

**Initial Assessment Study.** The dumping of battery acid was reported in the IAS (E&E 1983). This disposal practice may have caused a low pH and lead contamination in groundwater. The IAS also concluded that the acid would probably be neutralized from contact with the soil and that lead would bind to the soil, therefore reducing its migration into groundwater. Given the absence of groundwater usage in the area, the IAS recommended no further investigation at this site (E&E 1983).

**Site Investigation.** Soil and groundwater were sampled southeast of the forklift parking lot in an attempt to verify the location and areal extent of the acid disposal sump that had been reported by IT Corp. Three 4-foot-wide shallow trenches, 3 to 5 feet deep, were excavated in an "H" pattern with a backhoe in an area of stained soil identified by IT Corp. from historical aerial photographs as being the acid sump (Figure 6-7). A total of 16 soil samples were collected from 12 locations within the trenches, from 2 to 5 feet bgs. Two of these samples were collected from areas where surface soil staining was visually identified, and the remaining samples were evenly spaced throughout the trenches. A deep soil boring was drilled adjacent to the trench, in an area where the soil was stained, to collect soil samples for characterizing potential soil contamination at depth (Figure 6-7). The trench samples were field screened for pH, total transition metals (including chromium, cobalt, copper, iron, manganese, nickel, scandium, titanium, and vanadium), sulfate, and lead. The soil samples were analyzed in the laboratory for TPH, metals, pH, and sulfate. Additionally, two soil samples were collected to characterize runoff from the acid sump area and from the steam cleaning discharge line (Figure 6-7).

TPH-D was detected in boring ACS-13-SB, collected at a depth of 2.5 feet bgs, at a concentration of 5.79 mg/kg (Figure 6-8). The pH of the trench soil samples ranged from 7.70 to 8.83, and sulfate concentrations ranged from 18.2 to 1,130 mg/kg. No metals were detected in trench samples above the AM/3SD reference level. Eighteen metals were detected above the 95/95 TI (PRC/Montgomery Watson 1993a). As discussed in Section 5.3, the AM/3SD and 95/95 TI values were used in the SI as

benchmarks for metals results; however, the RI data will be compared to ambient concentration of metals.

The deep soil boring, ACS-06-SB, (Figure 6-7) was drilled adjacent to boring ACS-10-SB to a depth of 43 feet bgs, and soil samples were collected at 5-foot intervals until groundwater was encountered at 34 feet bgs. The soil profile consisted of interbedded silt and sand from the surface to about 22 feet bgs. Sandy gravel was found from approximately 22 to 40 feet bgs, underlain by clay to a total depth of 43 feet bgs. TPH-D was detected in three samples collected from boring ACS-06-SB at a maximum concentration of 5.36 mg/kg. TPH-gasoline (TPH-G) was detected in four samples at a maximum concentration of 0.131 mg/kg. TPH-G was detected in the samples collected from 0 to 20 feet, while TPH-D was detected in samples collected from 20 to 30 feet. The pH of the boring samples ranged from 7.00 to 8.81, and sulfate concentrations ranged from 4.74 to 154 mg/kg. Antimony (19.3 mg/kg) and manganese (1,950 mg/kg) were detected at concentrations greater than the AM/3SD level (Figure 6-9). However, both of these were detected at concentrations lower than their respective PRGs. Several metals were detected at concentrations greater than the 95/95 TI in the samples from 10, 20, 25, 30, and 40 feet bgs.

The results of pH and metals analysis of soils collected from the trenches and deep borings do not indicate that the reported acid sump was in the area investigated. Petroleum hydrocarbons detected in the reported acid sump area may be the result of surface water runoff, spillage from vehicles parked in the area, or the Building IA-55 UST.

A temporary well was set within the deep soil boring (ACS-06-SB) and screened from 33 to 43 feet bgs. Groundwater under confined hydrological conditions was measured in the well at a depth of 34 feet bgs. Because only one well was installed at the site, the groundwater gradient could not be measured during the SI. The topographic gradient at the site is west, toward Seal Creek (Figure 6-1).

Methylene chloride and trichloroethene (TCE) were detected at concentrations of 2 and 1 µg/L, respectively. Samples analyzed for TPH-D contained a maximum concentration of 364 µg/L. The pH of the groundwater samples ranged from 7.40 to 7.47, and sulfate concentrations ranged from nondetected to 88.90 mg/L. Due to the high silt and clay content of the grab sample, the groundwater sample for metals analysis was not field filtered. Therefore, the detected concentrations of metals probably



represent both the dissolved and particulate metals concentrations in the groundwater sample (PRC/Montgomery Watson 1993a).

The TPH-D detected in groundwater samples may be from diesel leaking from one of the UST systems or surface spillage of diesel migrating through the soil. The metal concentrations detected in the unfiltered groundwater sample represent both the dissolved and particulate metals, and do not reflect true groundwater metal concentrations.

Surface soil samples were collected at the termini of two runoff locations (Figure 6-7). The first sample, ACS-01-SFC, was collected near the culvert that drains storm water from the suspected acid sump area. Storm water from this area flows into a drainage ditch that discharges into a field. Soil sample ACS-01-SFC had a pH of 7.58, and contained TPH-D at a concentration of 17.8 mg/kg and sulfate at a concentration of 67.7 mg/kg (Figure 6-8). Cadmium (1.6 mg/kg) and lead (153 mg/kg) were detected above the three standard deviation level and may be elevated due to site activities (PRC and Montgomery Watson 1993a). The second surface sample, ACS-02-SFC, was collected at the end of the steam cleaning discharge line where it discharges into Seal Creek. This sample had a pH of 7.21 and contained TPH-D (164 mg/kg), TPH-G (0.082 mg/kg), and sulfate (44.5 mg/kg). Cadmium (3.1 mg/kg) and zinc (127 mg/kg) were detected at concentrations greater than AM/3SD reference levels; these metals may be elevated due to site activities. Chromium, cobalt, copper, manganese, mercury, and nickel concentrations were present at concentrations greater than the 95/95 TI in both surface soil samples. Although chromium, cobalt, copper, manganese, and nickel were present at concentrations greater than 95/95 TI, only arsenic, beryllium and nickel exceeded their respective PRGs (Figure 6-9). These results probably reflect a difference between the chemistry of native soils compared to eroded soils, and may indicate conditions that are a result of site activities.

**UST Investigation.** In September 1993, Harding Lawson Associates (HLA) conducted an investigation of the soil around the 2,000-gallon diesel fuel UST located along the southwest side of Building IA-24. One boring was drilled at the southeast corner of the UST. Samples were collected at depths of 7.5 and 10.5 feet bgs and were analyzed for TPH-D. TPH-D was not detected in the samples collected. The UST at Building IA-24 is scheduled for removal (HLA 1995).

In July 1994, HLA conducted a Phase I investigation of the soil around the 1,000-gallon diesel fuel UST located along the northwest side of Building IA-55. One boring was drilled at the southwest corner of the UST. Samples were collected at depths of 8.5 and 13.5 feet bgs and were analyzed for TPH-D. TPH-D was not detected in the samples collected. The UST at Building IA-55 is scheduled for removal and replacement with an aboveground storage tank (HLA 1995).

## **6.4 REMEDIAL INVESTIGATION FIELD ACTIVITIES**

Soil, sediment, and groundwater were sampled at Site 17 to evaluate the nature and extent of chemicals present as a result of past forklift maintenance activities and use of USTs. The site activities of greatest concern are the reported use of a battery acid disposal sump, use of a steam cleaner with a discharge line outfall into Seal Creek, and use of a fuel UST at Building IA-55. Soil, sediment, and groundwater samples were collected to assess whether these past site activities have contaminated environmental media at the site. Site drainage channels were sampled to assess whether contaminants are being transported off site. As part of the SWMU investigation (PRC 1996d), soil was sampled in the area of the septic tanks and leach field (samples S12-01 to S12-03) to evaluate whether soils at the site have been affected by effluent from the building sanitary system (Figure 6-8).

To evaluate the spatial extent of contaminants, the site has been divided into six areas based on past site activities and drainage features. These areas are (1) soils along the east side of Building IA-24 where the suspected acid dump may have been located; (2) soils and groundwater in the area of the Building IA-55 and IA-24 USTs; (3) the site drainage channels; (4) Seal Creek soils and sediments; (5) the septic tank and leach field; and (6) the area east of Building IA-24, where soil samples were collected to assess ambient metals concentrations at the site.

### **6.4.1 Utility Locating and Biological/Ecological Clearance**

Site reconnaissance consisted of a visual inspection of sampling locations, a biological/ecological clearance, and a utility clearance, the latter was conducted by NWS Concord personnel and representatives of the concerned utilities. The procedures for the biological/ecological clearance are discussed in the FSP (PRC/Montgomery Watson 1995b).

#### **6.4.2 Surface Soil and Sediment Sampling**

Surface soil samples were collected at six locations, ACSSB036 through ACSSB041, along the drainage channels that lead from Building IA-24 to Seal Creek (Figure 6-8). The samples were analyzed for SVOCs, TPH-E, TPH-P, metals, and pH.

Two surface sediment samples were collected in the stream bed of Seal Creek, approximately 50 feet upstream (ACSSB029) and 50 feet downstream (ACSSB031) of the former steam cleaning outfall. Sediment samples were analyzed for TPH-E, TPH-P, SVOCs, metals, and pH.

#### **6.4.3 Geoprobe Borings**

Geoprobe borings were drilled and soil was collected from seven locations, ACSSB020 through ACSSB026, located along the northeast and southeast sides of Building IA-24, to locate suspected acid dumping from old floor drain outfalls. Soil samples were collected at the surface and at 4 feet bgs and were analyzed for metals and pH.

Geoprobe borings were drilled and samples were collected at two locations, ACSSB028 and ACSSB030, near the former steam cleaning outfall in Seal Creek. Soil was collected at location ACSSB028, immediately below the outfall on the bank of Seal Creek, and sediment was collected in the stream bed below the outfall at ACSSB030. The samples were collected at the surface and at 3 feet bgs and analyzed for TPH-E, TPH-P, VOCs, SVOCs, metals, and pH.

Four Geoprobe soil borings, ACSSB032 through ACSSB035, were drilled upgradient (east) of the site at ambient locations. As discussed in Appendix A, the metal concentrations from these samples were used to determine ambient metal concentrations. Soil samples were collected at the surface and at a depth of 10 feet bgs and analyzed for metals and pH.

Three Geoprobe soil borings, S12-01 through S12-03, were drilled in the area of the septic tanks and leach field at part of the SWMU investigation. The samples were collected at approximate depths of 5 and 10 feet bgs, with samples also collected at 15 feet bgs from borings S12-01 and S12-03. The

samples were analyzed for VOCs, SVOCs, metals, and oil and grease. Samples collected from S12-02 were also analyzed for pH.

#### **6.4.4 Deep Soil Borings**

Soil boring ACSSB027 was drilled using a hollow stem auger rig to characterize soils in the vicinity of the Building IA-55 UST. Five soil borings, ACSMW010 through ACSMW014, were drilled for the installation of monitoring wells (Figure 6-8). ACSMW011 was drilled adjacent to the Building IA-55 UST, ACSMW010 was installed east of Building IA-24 near the area of the suspected acid sump, ACSMW012 was installed west of Building IA-24 immediately downgradient of the Building IA-24 UST, ACSMW013 was installed west of Building IA-24B adjacent to the drainage channel, and ACSMW014 was installed at the north end of the site adjacent to the drainage channel. Soil samples from all deep soil borings were collected at 10, 20, and 30 feet bgs and analyzed for TPH-E, VOCs, SVOCs, metals, and pH. In addition, a soil sample was collected from the water-bearing zone at 35 feet bgs in each borehole and was analyzed for TOC and geotechnical parameters.

#### **6.4.5 Monitoring Well Installation**

Soil borings were drilled by West Hazmat Drilling Corporation of Newark, California (California Well Driller C57 License #554979), using a truck-mounted rotary drill rig equipped with hollow-stem augers. All soil borings were hand augered to a depth of 5 feet bgs and probed an additional 4 feet prior to drilling. Five of the six deep soil borings at the site, ACSMW010 through ACSMW014, were completed as groundwater monitoring wells. Monitoring wells were constructed with 4-inch diameter Schedule 40 PVC well casings. Wells were screened with 0.010-inch machine slotted casing, placed from the bottom of the soil boring to approximately 5 feet above first encountered water levels. A filter pack consisting of No. 2/16 Monterey Sand was placed 1 to 2 feet above the top of the screened interval. The monitoring wells were sealed with a 3-foot layer of hydrated bentonite chips, followed by neat cement grout to the surface. Well construction diagrams are included as Appendix G. The wells were constructed and developed in accordance with the procedures outlined in the FSP (PRC/Montgomery Watson 1995b). Records of well development are included as Appendix H.

#### **6.4.6 Groundwater Sampling**

Within two weeks of installation in May 1995, groundwater samples were collected from each monitoring well and analyzed for TPH-E, VOCs, SVOCs, metals, pH, nitrate/nitrite, general minerals, and TSS. A second round of groundwater sampling was conducted in early September 1995 and the samples were analyzed for the above-listed parameters. Groundwater sampling forms are included as Appendix E.

#### **6.4.7 Summary of Quality Assurance/Quality Control Field Procedures**

Field QA/QC sampling conducted during the field effort at Site 17 consisted of the collection of field duplicates, referee duplicates, field blanks, equipment rinsates, and trip blanks in accordance with the FSP (PRC/Montgomery Watson 1995b). The results of these QA/QC samples are discussed in the QCSR (Appendix I). Field equipment was decontaminated in accordance with the procedures outlined in the Field Sampling Plan (PRC/Montgomery Watson 1995b). Field instruments used during the field effort were calibrated and maintained in accordance with the QAPjP (PRC/Montgomery Watson 1995c). Borings and samples were decontaminated in accordance with the WP and the FSP (PRC/Montgomery Watson 1995a,b).

#### **6.4.8 Deviations from Proposed Investigation Approach**

Two soil borings, ACSSB034 and ACSSB035, were drilled and sampled to provide additional chemical information to determine ambient metals concentrations. These soil borings were not specified in the FSP (PRC/Montgomery Watson 1995b). These borings were drilled and sampled in addition to the two borings specified in the FSP in order to allow for a larger data set to perform statistical evaluations for ambient soil concentrations.

### **6.5 CHEMICAL CHARACTERIZATION**

This section presents the results of chemical analyses for soil, sediment, and groundwater samples collected at Site 17. The samples collected during the RI at Site 17 were submitted for the laboratory

analyses described in Section 6.4 above and as presented in Tables 6-2 and 6-3. The analytical results are presented in Appendix J.

#### **6.5.1 Results of Soil and Sediment Sample Analyses**

This section presents the significant results of the soil sampling effort at Site 17. Soil samples were collected from Geoprobe borings, deep borings, and the ground surface at the locations described in Section 6.4. The results of soil sampling are compared to the PRGs established for residential soils (EPA 1995) (Appendix L). The soil results are also compared to TTLC values defined in Title 22 of the California Code of Regulations. TTLC values are used to categorize waste. If concentrations exceed the TTLC values, then the waste is defined to exhibit the characteristic of toxicity. In this RI, the TTLC values are not used to characterize waste, but instead are used to compare to soil concentrations to locate any hot spots (areas of unusually high concentrations). The results of sediment sampling are compared to effects range-median (ERM) and effects range-low (ERL) values (Long and others 1995). The chemicals with concentrations exceeding these criteria are the only chemicals discussed in the following sections, and these chemicals are carried into the HHRA. There are no established PRG, ERM, or ERL values for TPH constituents, and thus they are evaluated qualitatively.

##### **6.5.1.1 Organic Compounds in Soils and Sediment**

Organic compounds detected in Site 17 soils and sediment at concentrations exceeding PRG values, as well as all TPH detections, are shown on Figure 6-9. No organic compounds detected in Site 17 soils and sediments exceeded the TTLC values. No VOCs were detected at concentrations greater than PRGs in soil and sediment samples collected at Site 17. No organic constituents except TPH were detected in the soil/sediment samples collected from drainage ditches leading to Seal Creek.

SVOCs were detected during the RI only in surface soil samples collected in the drainage channels (Table 6-5). SVOCs were detected in samples collected at boring ACSSB036 (four compounds at concentrations up to 0.03 mg/kg), ACSSB037 (nine compounds at concentrations up to 0.06 mg/kg), ACSSB039 (10 compounds at concentrations up to 0.2 mg/kg), and ACSSB040 (11 compounds at concentrations up to 0.08 mg/kg) (Appendix J). Benzo(a)pyrene was detected in samples collected from ACSSB039 and ACSSB040 at concentrations of 0.1 and 0.07 mg/kg, respectively, which exceed the

PRG value of 0.061 mg/kg. No other SVOCs were detected in soil samples at concentrations exceeding PRGs. No SVOCs were detected in sediment samples collected from Seal Creek.

No petroleum hydrocarbons were detected from samples collected near the Building IA-55 UST (ACSMW011 and ACSSB027) or the Building IA-24 UST (ACSMW012). TPH-motor oil was detected in all drainage ditch surface samples at concentrations ranging from 36 to 1,300 mg/kg (Table 6-6). The samples collected at ACSSB039 and ACSSB040 contained TPH-motor oil at concentrations of 1,300 and 570 mg/kg, respectively. The surface soil sample collected at the outfall of the steam cleaning line contained TPH-motor oil at a concentration of 120 mg/kg. Surface sediments collected in Seal Creek, ACSSB029 through ACSSB031, contained TPH-motor oil at concentrations ranging from 110 to 180 mg/kg. The sediment sample collected from ACSSB030 at a depth of 3.0 to 3.5 feet bgs contained TPH-motor oil at a concentration of 4,100 mg/kg. TPH-oil and grease was detected in SWMU investigation soil samples at concentrations up to 64 mg/kg (S12-01 at 5.0-6.0 ft bgs).

#### **6.5.1.2 Inorganic Compounds in Soils and Sediment**

The ambient metal concentrations for Site 17 were calculated from metal concentrations detected in ambient soil samples (Appendix A). Inorganic compounds detected in Site 17 soils at concentrations exceeding PRG values are shown on Figures 6-9 and 6-12. The metals arsenic, beryllium, lead, manganese, nickel, and thallium were detected in soils collected at the site at concentrations exceeding PRG values (Table 6-7). No metals were detected in soil or sediment samples collected at the site at concentrations exceeding TTLC values. The metals cadmium, copper, lead, mercury, nickel, and zinc were detected in the surface drainage channel soil samples or Seal Creek sediments at concentrations exceeding ERLs or ERMs. The distribution of arsenic, beryllium, cadmium, copper, lead, manganese, mercury, nickel, thallium, and zinc in site soil samples is discussed below.

##### **Arsenic**

Arsenic was detected in the majority of the samples collected at Site 17 at concentrations exceeding its PRG. However, ambient concentrations of arsenic greatly exceed the PRG value (7.3 mg/kg compared to 0.38 mg/kg), and no samples contained arsenic at concentrations exceeding ambient values, indicating that arsenic concentrations found in the samples are probably indigenous to the area.

## **Beryllium**

Beryllium detections exceeded its PRG in the majority of soil samples; however, the ambient value of beryllium is greater than its PRG, [0.56 mg/kg(ambient); 0.14 mg/kg(PRG)]. Only one sample (surface sample ACSSB038) exceeded the site ambient value.

## **Cadmium**

Cadmium was detected in surface soil samples collected from drainage channel locations ACSSB036 through ACSSB040, and steam clean discharge line sample ACSSB028 at concentrations exceeding the site ambient concentration of 0.56 mg/kg. Cadmium was detected at a concentration exceeding the ERL value of 1.2 mg/kg in one surface drainage channel soil sample collected at ACSSB039 (2.4 mg/kg). The spatial distribution of cadmium indicates that its presence may be the result of past site activities; however, its use at the site is not clear. Batteries maintained at the site are likely to have been lead-acid, rather than nickel-cadmium.

## **Copper**

Copper was detected at concentrations exceeding the ERL value of 34 mg/kg in sediment samples collected at ACSSB030 (3.0 to 3.5 feet bgs) and ACSSB031 (surface) at concentrations of 44.3 and 38.4 mg/kg, respectively. Copper was detected at concentrations exceeding the ERL value of 34 mg/kg in three surface drainage channel soil samples collected at ACSSB038 (42.3 mg/kg), ACSSB039 (63.4 mg/kg), and ACSSB041 (37.3 mg/kg). Copper was not detected at concentrations exceeding its ERM value of 270 mg/kg.

## **Lead**

Lead was detected in two drainage channel surface soil samples at concentrations exceeding the PRG value of 130 mg/kg. Borings ACSSB036 and ACSSB039 contained lead at concentrations of 157 and 225 mg/kg, respectively. Surface soil samples collected at drainage channel surface locations ACSSB037, ACSSB038, ACSSB040, Building IA-24 surface soil sample ACSSB020, Building IA-55 UST boring sample ACSSB027 (10.0 to 11.0 feet bgs), and ambient surface soil sample ACSSB032



contained lead at concentrations greater than the site ambient concentration of 18 mg/kg. Lead was detected at concentrations exceeding the ERL value of 46.7 mg/kg in four surface drainage channel soil samples collected at ACSSB036 (157 mg/kg), ACSSB037 (52.2 mg/kg), ACSSB039 (225 mg/kg), and ACSSB040 (62.3 mg/kg). The soil sample collected from ACSSB039 (225 mg/kg) also exceeded the lead ERM value of 218 mg/kg. The relatively elevated concentrations in surface soil samples collected from the drainage channels may be the result of site maintenance involving lead-acid batteries.

### **Manganese**

Manganese was detected in the SWMU investigation sample S12-03 (15.0 to 16.0 ft bgs) at a concentration of 12,100 mg/kg, which exceeds the PRG of 3,200 mg/kg. No other SWMU investigation soil sample contained manganese at concentrations exceeding 800 mg/kg. The presence of elevated manganese concentrations in this SWMU investigation sample is not consistent with the known site uses.

### **Mercury**

Mercury was detected at a concentration exceeding the ERL value of 0.15 mg/kg in one surface drainage channel soil sample collected at ACSSB039 (0.24 mg/kg). Mercury was not detected at concentrations exceeding its ERM value of 0.71 mg/kg.

### **Nickel**

Nickel was detected in four soil samples collected during the RI at concentrations exceeding the PRG value of 150 mg/kg. These samples were collected at depths of 19.5 feet bgs or greater in borings ACSMW010, ACSMW014 (two sample intervals), and ACSSB027 (up to 203 mg/kg in ACSSB027 [19.5 to 20 feet bgs]). Increasing nickel concentrations with depth probably reflect variation in geology/sedimentology, and are not the result of site activities, which would likely affect surface samples to a greater degree. Nickel was detected at concentrations exceeding the site ambient value of 86 mg/kg in other samples collected from depths greater than 9.5 feet bgs in the monitoring well soil borings, in Building IA-55 UST boring ACSSB027, and in steam cleaning discharge line outfall sample ACSSB028. Nickel was detected at concentrations exceeding the PRG value in SWMU investigation sample S12-02 (165 mg/kg at 5.0 to 6.0 feet bgs) and at concentrations exceeding the site ambient value

in three samples including the above-mentioned one collected during the SWMU investigation. Nickel was detected at concentrations exceeding the ERL value of 20.9 mg/kg in four surface drainage channel soil samples collected at ACSSB038 (33.5 mg/kg), ACSSB039 (33.3 mg/kg), ACSSB040 (37 mg/kg), and ACSSB041 (68.6 mg/kg). The soil sample collected from ACSSB041 (68.6 mg/kg) also exceeded the nickel ERM value of 51.6 mg/kg. Nickel was detected at concentrations exceeding the ERM value of 51.6 mg/kg in sediment samples collected at ACSSB030 (3.0 to 3.5 feet bgs) and ACSSB031 (surface) at concentrations of 59.0 and 54.1 mg/kg, respectively. Nickel was detected at concentrations exceeding the ERL value of 20.9 mg/kg in the above-mentioned sediment samples, as well as in surface sediment samples ACSSB029 (51.1 mg/kg) and ACSSB030 (48.7 mg/kg).

### **Thallium**

Thallium was detected in SWMU investigation sample S12-03 (15.0-16.0 ft bgs) at a concentration of 15.6 mg/kg, exceeding the PRG value of 5.4 mg/kg. All samples collected along the northeast and southeast side of Building IA-24 and all samples collected during the SWMU investigation contained thallium at concentrations exceeding the site ambient concentration. The only other thallium detection was at the steam cleaner discharge line (ACSSB028). No other samples collected at the site contained thallium. The spatial distribution of thallium indicates that its presence may be the result of past site activities; however, its likely use at the site is not clear. Thallium has been used in rat and ant poisons (Merck & Co., Inc. 1983), which may explain its presence around the perimeter of Building IA-24.

### **Zinc**

Zinc was detected in surface soil samples collected from drainage channel locations ACSSB036 through ACSSB040, and steam clean discharge line sample ACSSB028 at concentrations exceeding the site ambient concentration of 83 mg/kg. Zinc was detected at a concentration exceeding the ERL value of 150 mg/kg in two surface drainage channel soil samples collected at ACSSB037 (156 mg/kg) and ACSSB039 (200 mg/kg). The spatial distribution of zinc indicates that its presence may be the result of past site activities; however, its potential use at the site is not clear.

Low pH conditions that might be associated with use of an acid sump were not encountered in samples collected during the RI or the SWMU investigation. Measured pH values in soil and sediment samples ranged from 6.6 to 8.8.

## **6.5.2 Results of Groundwater Analyses**

This section presents the significant results of the two groundwater sampling events at Site 17. Organic compounds detected in Site 17 groundwater samples at concentrations exceeding PRG values, as well as all TPH detections, are shown on Figure 6-11. Unfiltered groundwater samples were collected from the five monitoring wells in late May and early September 1995. The wells were installed at the locations described in Section 6.4.5. The results of groundwater sampling are compared to the PRGs established for tap water (EPA 1995) (Appendix L). There are no established PRGs for TPH constituents.

### **6.5.2.1 Organic Compounds in Groundwater**

Although TCE and methylene chloride were detected during the SI below MCLs, no VOCs were detected in groundwater sampled from the monitoring wells during the two sampling events.

The SVOC bis(2-ethylhexyl)phthalate was detected in the samples collected from wells ACSMW010 and ACSMW012 during the first sampling event, at concentrations of 60 and 55 µg/L, respectively, which exceed the PRG value of 4.8 µg/L (Table 6-8). Bis(2-ethylhexyl)phthalate was not detected in any well during the second sampling event. Bis(2-ethylhexyl)phthalate is a common laboratory contaminant. No other SVOCs were detected in the monitoring well samples during either sampling event.

Motor oil was detected in the groundwater sample collected from well ACSMW010 at a concentration of 0.1 mg/L during the first monitoring event (Table 6-8). TPH-D was detected in the sample collected from well ACSMW014 at a concentration of 0.06 mg/L during the second monitoring event. No other petroleum hydrocarbons were detected in any other groundwater samples during either sampling event. Although TPH-diesel was detected in the groundwater at a maximum concentration of 364 µg/L during the SI, motor oil was detected at a maximum concentration of 0.1 mg/L in the groundwater during the RI. The inconsistency in the different fuel types detected during the two investigations is attributed to different target analytes requested for each investigation as explained in Section 3.3. Variation in the

groundwater results may be attributed to the field collection method. During the SI, grab groundwater samples were collected whereas during the RI, the low flow purge method was used to obtain groundwater samples. The different field collection methods make direct comparison of analytical results from the SI and RI difficult.

#### **6.5.2.2 Inorganic Compounds in Groundwater**

No metals were detected in the groundwater samples collected at the site at concentrations exceeding PRGs.

#### **6.5.3 Summary of Chemical Characterization**

As stated in Section 6.4, the site was divided into six study areas to assess the spatial extent of chemicals at the site. This section summarizes the organic and inorganic chemicals detected within the five study areas associated with site activities and drainage. The sixth area contained the locations of the ambient soil samples, and those results were used to calculate ambient metal concentrations. Analytical results relating to the whole site are summarized and then the analytical results from the study areas are discussed.

No VOCs were detected in soil, sediment, and groundwater samples collected during the RI at Site 17.

Arsenic and beryllium were detected in the majority of the soil samples collected during the RI at concentrations exceeding PRG values; however, no arsenic concentrations and only one beryllium concentration exceeded site ambient values, indicating that these concentrations detected in site samples are indigenous. Thallium was detected only in RI surface samples collected at Building IA-24, the steam cleaner discharge line, Seal Creek samples, and in the SWMU samples. The presence of thallium in distinct areas of the site is probably indicative of past site activities.

#### **Building IA-24**

Measured pH values in soil and sediment samples collected at the site did not identify the location of the suspected former acid sump.

Nickel was detected at concentrations exceeding the PRG in four samples collected at 19.5 feet bgs or greater and at concentrations exceeding the site ambient value in other samples collected from depths greater than 9.5 feet bgs. Increasing nickel concentrations with depth probably reflect changes in geology/sedimentology.

## **USTs**

No petroleum hydrocarbons were detected in soil samples collected near the fuel USTs.

No VOCs were detected in groundwater sampled from the monitoring wells during the two sampling events. The SVOC bis(2-ethylhexyl)phthalate was detected in the samples collected during the first sampling event at concentrations exceeding (up to 60 µg/L) the PRG value (4.8 µg/L), but not during the second sampling event. No other SVOCs were detected in monitoring well samples during either sampling event. Petroleum hydrocarbons have not been detected consistently in groundwater samples collected at the site.

## **Drainage Channel**

SVOCs at concentrations equal to or less than 0.2 mg/kg were detected in RI samples collected in the drainage channels. Benzo(a)pyrene was detected in the samples collected from boring ACSSB039 and ACSSB040 at concentrations of 0.1 and 0.07 mg/kg, respectively, which exceed the PRG value. TPH-motor oil was detected in drainage ditch surface samples at concentrations up to 1,300 mg/kg.

Lead was detected in two drainage channel surface soil samples at concentrations exceeding the PRG and ambient values, in four drainage channel soil samples at concentrations exceeding the ERL or ERM value, and in three additional drainage channel locations at concentrations greater than site ambient values. Cadmium was also detected in surface samples collected from five drainage channel locations at concentrations exceeding the site ambient value and one drainage channel soil sample was detected at a concentration exceeding the ERL value. The spatial distribution of lead and cadmium may be the result of site activities. Copper was detected in drainage channel soil samples at concentrations exceeding the ERL value. Mercury was detected in three drainage channel soil samples at concentrations exceeding the ERL value. Nickel was detected in four drainage channel soil samples at concentrations exceeding the

ERL or ERM value. Zinc was detected in two drainage channel soil samples at concentrations exceeding the ERL value.

### **Seal Creek**

Sediments collected in Seal Creek contained TPH-motor oil at concentrations up to 4,100 mg/kg.

Nickel concentrations in two sediment samples collected in Seal Creek exceeded the ERM value; however, no anthropogenic sources of nickel at Site 17 were indicated during the RI, and these sediment concentrations are probably also indigenous to the site. Copper was detected in one sediment sample at a concentration exceeding the ERM value.

### **Leach Field**

TPH-oil and grease was detected in the SWMU investigation soil samples at concentrations up to 64 mg/kg. Manganese was detected in one SWMU investigation sample at a concentration exceeding the PRG value.

## **6.6 REVISED CONCEPTUAL SITE MODEL**

The conceptual site model was developed after the SI and is presented in the WP (PRC/Montgomery Watson 1995a). This conceptual site model has been updated to include the RI data. The model lists potential sources and COPCs identified in Section 6.5, and highlights the most likely migration routes (Figure 6-14). The model is used in conjunction with the results from the human health and ecological risk assessments and the fate and transport properties of the COPCs to assess site conditions and the need for remediation. Site 17 is located in a flat area that is crossed by Kinne Boulevard. Maintenance activities occur in localized sections of the site. Although battery acid was reportedly disposed of in a sump adjacent to the building, no evidence to indicate the presence of the sump was found during the SI or the RI. In the SI sampling, TPH was detected in soil near an UST and at the terminus of a drainage pipe leading from a steam cleaning area. The SI and RI data indicate chemicals are in the groundwater, drainage ditch soil, and Seal Creek sediments. Chemicals may be transported off site through surface

water, erosion, and through drainage pipes that lead to the Seal Creek wash. The wind transport and volatilization pathways are not significant, because no VOCs were detected at Site 17 during the RI.

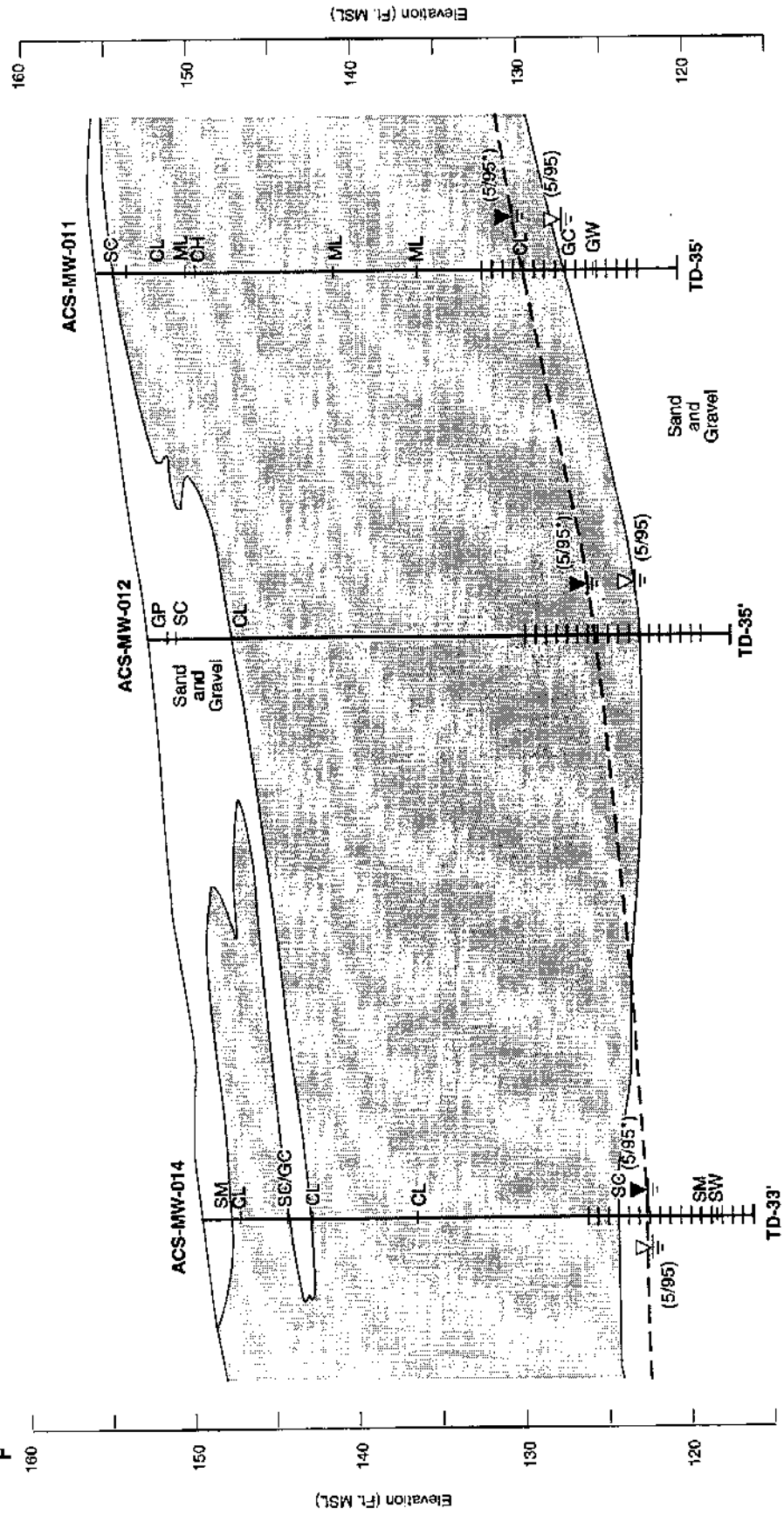
## Figures 6-1 and 6-2

These detailed station maps have been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.



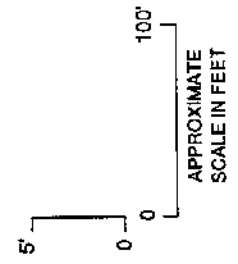
NORTHWEST  
F'

SOUTHEAST  
F'



LEGEND

- Depth to First Encountered Groundwater (Date)
- Static Water Level (Date)
- Water Level Collected During Groundwater Sampling and Gauging Event
- Projected Potentiometric Surface
- Monitoring well screened interval
- Sand and Gravel
- Clay and Silt



NWS CONCORD - INLAND AREA  
CONCORD, CALIFORNIA

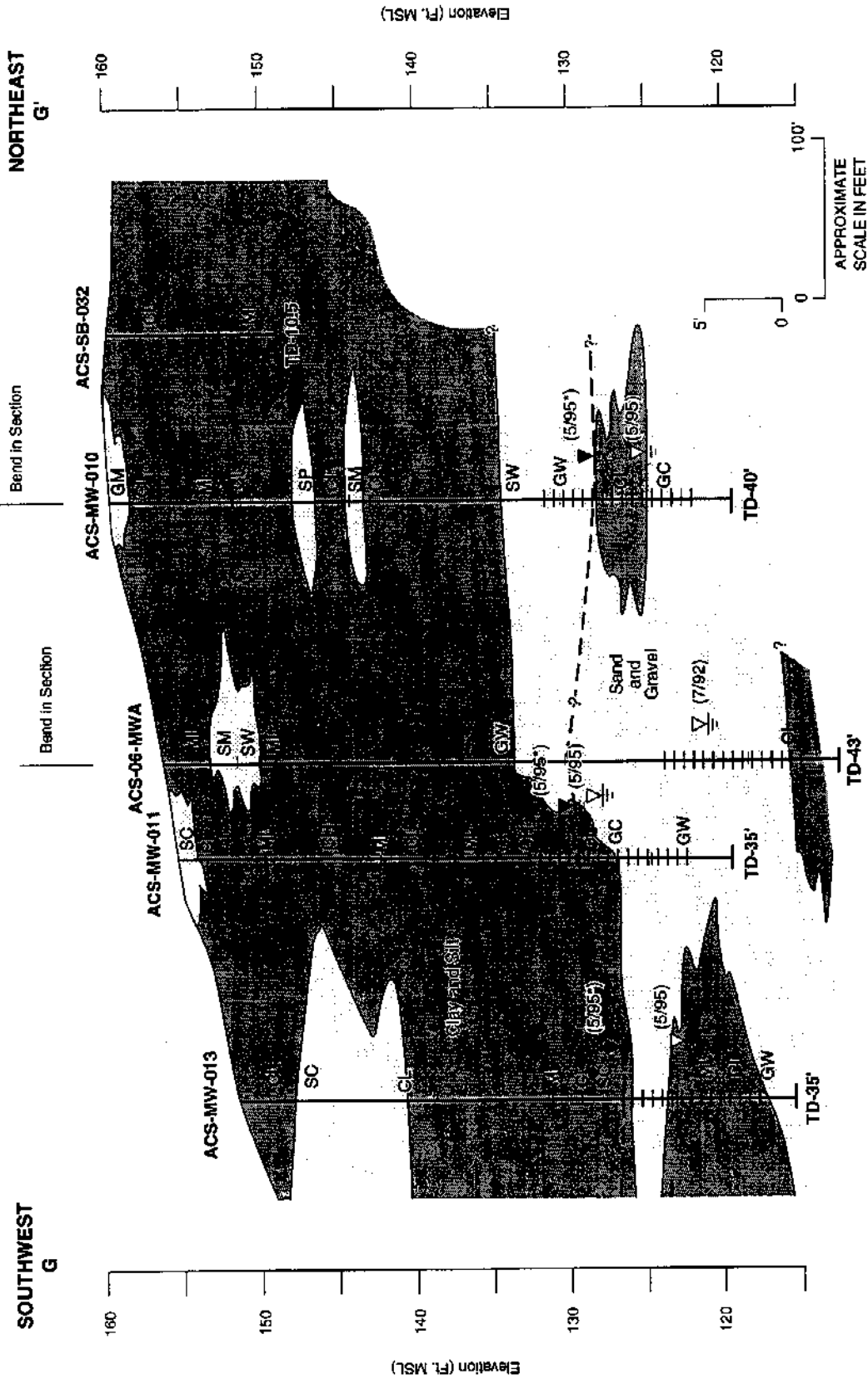
FIGURE 6-3  
SITE 17  
HYDROGEOLOGIC CROSS SECTION F-F'

SIZE	DATE	DWG NAME	REV
	06/05/96		1

06/96 CO

**SOUTHWEST  
G'**

**NORTHEAST  
G'**



**LEGEND**

- ▽ Depth to First Encountered Groundwater (Date)
- ▼ Static Water Level (Date)
- Water Level Collected During Groundwater Sampling and Gauging Event
- — — Projected Potentiometric Surface
- Sand and Gravel
- Clay and Silt
- ⊢ Monitoring well screened interval

**NWS CONCORD - INLAND AREA  
CONCORD, CALIFORNIA**

**FIGURE 6-4**

**SITE 17**

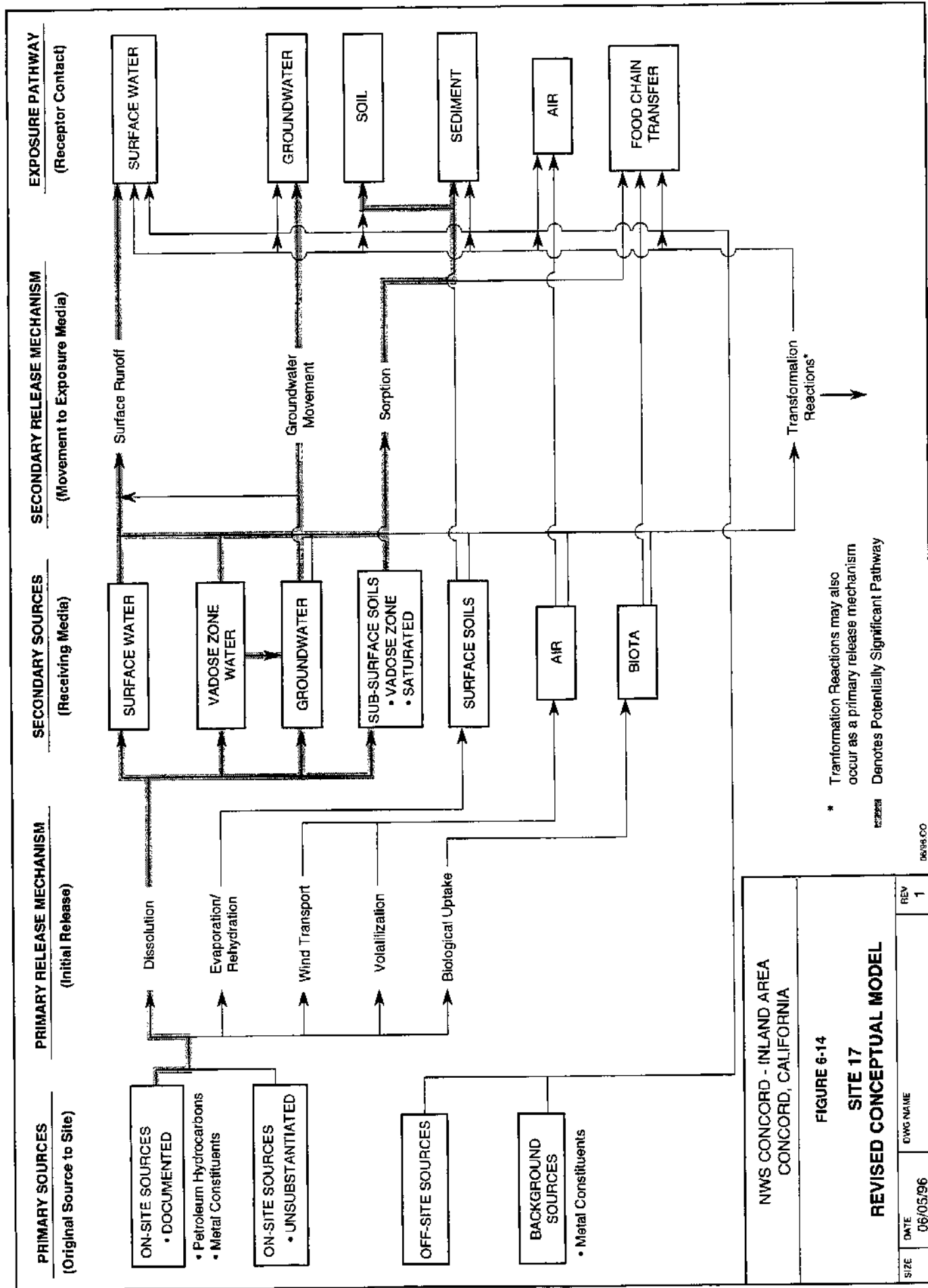
**HYDROGEOLOGIC CROSS SECTION G-G'**

SIZE	DATE	DWG NAME	REV
	06/05/96		1

DM/96.CO

## Figures 6-5 - 6-13

These detailed station maps have been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.



NWS CONCORD - INLAND AREA CONCORD, CALIFORNIA			
FIGURE 6-14			
SITE 17			
REVISED CONCEPTUAL MODEL			
SIZE	DATE	DWG NAME	REV
	06/05/96		1

TABLE 6-1

**REMEDIAL INVESTIGATION  
SUMMARY OF GEOTECHNICAL TESTING RESULTS  
SITE 17 - BUILDING 1A-24  
WPNSTA CONCORD**

Laboratory Identification	Soil Sample Location	Sample Interval (feet bgs)	Grain Size	USCS Symbol	Permeability (cm/sec)	Porosity (%)	Density lb/ft <sup>3</sup>	Specific Gravity	Moisture (%)
CS514	ACSMW010	34.0-35.0	Clayey, gravelly sand	SC	2.00E-04	31.69	117.7	2.76	3.9
CS518	ACSMW011	31.0-31.5	Gravel	GW	5.00E-02	31.74	119.7	2.81	9.8
CS522	ACSMW012	31.0-31.5	Sand with gravel	SP	7.00E-04	34.29	116.0	2.83	14.5
CS526	ACSMW014	35.0-35.5	Gravel with clay	GW-GM	4.00E-04	29.19	124.6	2.82	11.9
CS530	ACSMW013	32.5-33.5	Gravelly sand	SP	1.00E-03	27.87	125.1	2.78	11.1
CS534	ACSSB027	35.0-35.5	Gravel	GP-GM	6.00E-02	24.10	132.1	2.79	9.1



TABLE 6-2

**SUMMARY OF SEDIMENT AND SOIL ANALYSES, SITE 17  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD  
(CONTINUED)**

Sample Location	Investigation	Matrix	Sample Depth	Organic Compounds				Inorganic Constituents			Other Parameters						
				CLP SVOC	TPH Extractable	TPH Purgeable	VOCs	Oil/Grease	Hex. Chromium	CLP Metals	WET-DI	Geophys. Param.	Grain Size	Percent Moisture	pH	TOC	
ACSSB025	RI	Soil	1 - 1.5							1	1					1	
	RI	Soil	3 - 3.5							1	1					1	
ACSSB026	RI	Soil	1.5 - 2								1					1	
	RI	Soil	3 - 5								1					1	
ACSSB027	RI	Soil	1 - 11	1	1		1				1					1	
	RI	Soil	2 - 21	1	1		1				1					1	
	RI	Soil	3 - 31	1	1		1				1					1	
	RI	Soil	35 - 36									1	1			1	1
	RI	Soil	0 - .5	1	1	1					1	1				1	
ACSSB028	RI	Soil	2.5 - 3	1	1	1					1	1				1	
	RI	Soil	0 - .5	1	1	1					1	1				1	
ACSSB036	RI	Soil	0 - .5	1	1	1					1	1				1	
ACSSB037	RI	Soil	0 - .5	1	1	1					1	1				1	
ACSSB038	RI	Soil	0 - .5	1	1	1					1	1				1	
ACSSB039	RI	Soil	0 - .5	1	1	1					1	1				1	
ACSSB040	RI	Soil	0 - .5	1	1	1					1	1				1	
ACSSB041	RI	Soil	0 - .5	1	1	1					1	1				1	
S12-01	SWMU	Soil	5 - 6	1			1	1			1	1					
	SWMU	Soil	11 - 12	1			1	1			1	1					
	SWMU	Soil	15 - 15.5	1			1	1			1	1					
S12-02	SWMU	Soil	5 - 6	1			1	1			1	1				1	
	SWMU	Soil	1 - 11	1			1	1			1	1				1	
S12-03	SWMU	Soil	5 - 6	1			1	1			1	1					
	SWMU	Soil	1 - 11	1			1	1			1	1					
	SWMU	Soil	15 - 16	1			1	1			1	1					
Total:				38	30	9	28	8	9	52	6	6	6	6	12	47	6

Note:

Section 3.0 tables list the analytical methods used and Appendix I, Quality Control Summary Report, describes quality assurance samples.

TABLE 6-3

**SUMMARY OF WATER ANALYSES, SITE 17  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

Sample Location	Investigation	Matrix	Sample Date	Organic Compounds						Inorganic Constit.	Other Parameters			
				Aromatic Volatiles	Explos.	CLP SVOC	TPH Extract.	TPH Purge.	VOC		pH	TSS	TOC	Cond./ Hardness
ACSMW010	RI	Groundwater	5/25/95			1	1		1	1	1	1	1	1
	RI	Groundwater	9/6/95			1	1		1	1	1	1	1	1
ACSMW011	RI	Groundwater	5/30/95			1	1		1	1	1	1	1	1
	RI	Groundwater	9/8/95			1	1		1	1	1	1	1	1
ACSMW012	RI	Groundwater	5/26/95			1	1		1	1	1	1	1	1
	RI	Groundwater	9/7/95			1	1		1	1	1	1	1	1
ACSMW013	RI	Groundwater	5/31/95			1	1		1	1	1	1	1	1
	RI	Groundwater	9/8/95			1	1		1	1	1	1	1	1
ACSMW014	RI	Groundwater	5/26/95			1	1		1	1	1	1	1	1
	RI	Groundwater	9/7/95			1	1		1	1	1	1	1	1
Total:				0	0	10	11	1	11	11	11	11	10	11

## Notes:

Section 3.0 tables list the analytical methods used and Appendix I, Quality Control Summary Report, describes quality assurance samples.

Explos. - Explosive Compounds

TPH Extract. - Extractable total petroleum hydrocarbons

TPH Purge. - Purgeable total petroleum hydrocarbons

TSS - Total suspended solids

TOC - Total organic carbon



TABLE 6-4

SUMMARY OF DETECTED VOCs IN SOIL  
SITE 17 - BUILDING IA-24  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD

Sample Location	Investigation	Sample Depth (ft bgs)	1,2-Dichloropropane	2-Butanone	4-Methyl-2-pentanone	Acetone	Carbon Disulfide	Chloroform	Toluene	Trichloroethene	Xylene (Total)
Residential PRGs (mg/kg)			0.31	NE	NE	2,100	7.5	0.25	790	3.2	320
Concentration (mg/kg)											
S12-01	SWMU	15 - 15.5	--	--	0.004	--	--	--	--	--	--
S12-02	SWMU	1 - 11	0.058	--	--	--	--	--	--	--	--
S12-03	SWMU	15 - 16	--	--	0.005	--	--	--	--	--	--

NE - Not Established

Concentrations shown in **bold** exceed the residential PRG.

Appendix J contains full analytical tables which include the date sampled, samples with nondetected concentrations, and detection limits.

TABLE 6-5

SUMMARY OF DETECTED SVOCs IN SOIL  
SITE 17 - BUILDING 1A-24  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD

Sample Location	Investigation	Sample Depth (ft bgs)	Concentration (mg/kg)															Total PAHs	
			Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Chrysene	Fluoranthene	Phenanthrene	Phenol	Pyrene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Dibenz(a,h)anthracene	Indeno(1,2,3-cd)pyrene	High Molecular Weight PAHs	Low Molecular Weight PAHs	NE	NE	
Residential PRGs (mg/kg)																			
ACSSB036	RI	0 - .5	--	--	--	0.021	0.029	0.022	--	0.028	--	--	--	0.078	0.022	0.1			
ACSSB037	RI	0 - .5	0.023	0.033	0.033	0.046	0.048	--	--	0.056	0.032	0.043	--	0.027	0.309	0.023	0.332		
ACSSB039	RI	0 - .5	0.087	0.11	0.11	0.15	0.16	0.07	--	0.19	0.099	0.13	--	0.083	1.02	0.157	1.177		
ACSSB040	RI	0 - .5	0.062	0.073	0.083	0.11	0.14	0.06	--	0.15	0.066	0.082	0.024	0.05	0.774	0.122	0.896		
S12-01	SWMU	5 - 6	--	--	--	--	--	--	0.76	--	--	--	--	--	--	--	--		
S12-02	SWMU	5 - 6	--	--	--	--	--	--	0.54	--	--	--	--	--	--	--	--		
	SWMU	1 - 11	--	--	--	--	--	--	0.57	--	--	--	--	--	--	--	--		
S12-03	SWMU	5 - 6	--	--	--	--	--	--	0.57	--	--	--	--	--	--	--	--		

NE - Not Established

Concentrations shown in **bold** exceed the residential PRG.

Appendix J contains full analytical tables which include the date sampled, samples with nondetected concentrations, and detection limits.

TABLE 6-6

**SUMMARY OF DETECTED TPH IN SOIL  
SITE 17 - BUILDING IA-24  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

Sample Location	Investigation	Sample Depth (ft bgs)	Diesel	Motor Oil
Residential PRGs (mg/kg)			NE	NE
			Concentration (mg/kg)	
ACSSB028	RI	0 - .5	--	120
	RI	2.5 - 3	--	75
ACSSB029	RI	0 - .5	--	160
ACSSB030	RI	0 - .5	--	110
	RI	3 - 3.5	--	4,100
ACSSB031	RI	0 - .5	--	180
ACSSB036	RI	0 - .5	--	54
ACSSB037	RI	0 - .5	--	120
ACSSB038	RI	0 - .5	--	160
ACSSB039	RI	0 - .5	--	1,300
ACSSB040	RI	0 - .5	--	570
ACSSB041	RI	0 - .5	--	36

NE - Not Established

TABLE 6-7

**SUMMARY OF DETECTED METALS IN SOIL**  
**SITE 17 - BUILDING 1A-24**  
**INLAND AREA REMEDIAL INVESTIGATION**  
**NWS CONCORD**

Sample Location	Investigation	Sample Depth (ft bgs)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Silver	Thallium	Vanadium	Zinc
Residential PRGs (mg/kg)			77,000.00	31.00	0.38	5,300.00	0.14	9.00	77,000.00	4,600.00	2,800.00	130.00	3,200.00	23.00	380.00	150.00	380.00	5.40	540.00	23,000.00
Concentrations of Total Metals (mg/kg)																				
ACSMW010	RI	9.5 - 10	14,800.00	--	4.50	210.00	--	--	51.50	20.30	50.40	8.20	718.00	--	--	92.20	--	--	58.00	78.70
	RI	19.5 - 20	17,100.00	--	4.40	187.00	--	--	61.50	27.40	67.80	8.10	877.00	--	--	188.00	--	--	64.10	82.70
	RI	29.5 - 30	9,870.00	--	--	78.40	--	--	31.20	10.30	36.10	3.70	786.00	--	--	68.90	--	--	53.80	46.40
ACSMW011	RI	10 - 10.5	18,800.00	--	7.00	224.00	--	--	53.50	20.70	57.90	9.20	724.00	--	--	107.00	--	--	70.80	83.60
	RI	20 - 20.5	9,930.00	--	5.40	156.00	--	--	24.00	11.00	26.10	10.70	381.00	--	--	31.90	--	--	37.90	60.60
	RI	30 - 31	16,300.00	--	4.30	92.20	--	--	61.70	19.50	72.80	13.50	724.00	--	--	98.50	--	--	62.40	63.50
ACSMW012	RI	10 - 10.5	14,100.00	--	--	226.00	--	--	39.90	20.70	54.80	9.60	735.00	0.07	--	101.00	--	--	63.70	76.90
	RI	20 - 20.5	16,800.00	--	5.90	228.00	--	--	40.70	19.80	46.30	9.20	701.00	--	--	69.50	--	--	65.80	77.50
	RI	30 - 30.5	10,400.00	--	5.10	167.00	--	--	29.90	15.10	28.20	7.20	841.00	--	--	50.10	--	--	44.40	49.80
ACSMW013	RI	9.5 - 10	18,100.00	--	--	145.00	--	--	65.80	23.70	72.20	4.80	838.00	--	--	100.00	--	--	77.10	84.40
	RI	19.5 - 20	13,500.00	--	4.20	230.00	0.41	--	24.40	12.70	25.20	8.00	552.00	--	--	42.30	--	--	38.00	59.20
	RI	29.5 - 30	6,750.00	--	5.50	84.80	--	--	31.00	11.30	24.30	4.70	438.00	--	--	34.00	--	--	41.80	35.90
ACSMW014	RI	9.5 - 10	8,380.00	--	3.60	179.00	--	--	20.70	11.20	19.90	6.20	370.00	--	--	33.00	--	--	36.20	61.50
	RI	19.5 - 20	17,100.00	--	5.10	181.00	--	--	60.20	29.00	81.20	7.80	901.00	0.08	--	203.00	--	--	74.80	83.90
	RI	29.5 - 30	16,100.00	--	4.40	129.00	--	--	61.50	27.80	69.40	6.20	1050.00	0.13	--	189.00	--	--	77.40	71.00
ACSSB020	RI	0 - 5	13,100.00	--	6.40	106.00	0.44	--	24.10	9.20	21.30	26.10	323.00	--	--	21.00	--	0.24	44.80	54.80
	RI	3 - 4	12,100.00	--	3.90	116.00	0.42	--	21.70	9.10	16.70	5.00	287.00	--	--	19.30	--	0.20	39.20	45.90
ACSSB021	RI	0 - 5	11,700.00	--	4.00	121.00	0.45	--	21.20	9.00	19.90	5.10	267.00	--	--	18.10	--	0.26	41.10	51.80
	RI	3 - 4	10,900.00	--	3.60	119.00	0.41	--	19.80	10.10	19.00	4.90	309.00	--	0.40	17.50	--	0.28	38.10	47.60
ACSSB022	RI	0 - 5	12,600.00	--	4.10	114.00	0.41	--	22.70	9.20	54.10	68.80	283.00	--	--	17.80	--	1.20	40.50	48.20
	RI	3 - 4	13,200.00	--	3.20	114.00	0.40	--	22.50	8.10	16.50	4.40	250.00	--	--	16.60	--	0.40	41.50	45.00
ACSSB023	RI	0 - 5	12,300.00	--	3.80	149.00	0.40	--	22.90	15.20	18.10	12.10	529.00	--	--	21.40	--	0.31	42.00	37.50
	RI	3 - 4	10,900.00	--	3.50	123.00	0.40	--	21.10	8.90	16.90	6.60	278.00	--	--	18.90	--	0.31	37.80	45.60
ACSSB024	RI	0 - 5	11,500.00	--	3.50	111.00	0.39	--	20.60	9.40	16.70	4.90	307.00	--	--	17.70	--	0.24	37.40	42.50
	RI	3 - 3.75	12,500.00	--	3.50	144.00	0.43	--	22.70	9.70	16.00	6.10	298.00	--	--	18.10	--	0.24	40.30	44.50
ACSSB025	RI	1 - 1.5	11,400.00	--	4.00	110.00	0.48	--	21.50	8.80	21.70	7.00	236.00	--	--	17.20	--	0.29	39.00	48.50
	RI	3 - 3.5	8,780.00	--	3.10	105.00	0.34	--	18.50	20.20	16.10	5.00	863.00	--	--	23.40	--	0.16	37.90	23.30
ACSSB026	RI	1.5 - 2	10,100.00	--	3.20	132.00	0.33	--	19.70	17.20	17.10	5.80	683.00	--	--	22.20	--	0.12	42.30	29.00
	RI	3 - 5	9,890.00	--	3.10	109.00	0.36	--	18.40	12.30	14.70	5.00	339.00	--	--	14.40	--	0.21	35.90	32.50

TABLE 6-7

**SUMMARY OF DETECTED METALS IN SOIL**  
**SITE 17 - BUILDING 1A-24**  
**INLAND AREA REMEDIAL INVESTIGATION**  
**NWS CONCORD**  
**(CONTINUED)**

Sample Location	Investigation	Sample Depth (ft bgs)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Silver	Thallium	Vanadium	Zinc
Residential PRGs (mg/kg)			77,000.00	31.00	0.38	5,300.00	0.14	9.00	77,000.00	4,600.00	2,800.00	130.00	3,200.00	23.00	380.00	150.00	380.00	5.40	540.00	23,000.00
Concentrations of Total Metals (mg/kg)																				
ACSSB027	RI	10 - 11	18,500.00	--	7.30	326.00	--	--	52.40	22.10	67.20	21.90	847.00	--	--	106.00	--	--	69.40	89.50
	RI	20 - 21	16,500.00	--	5.70	191.00	--	--	55.90	26.50	67.10	8.70	883.00	--	--	169.00	--	--	65.80	84.30
	RI	30 - 31	8,230.00	--	3.50	93.40	--	--	24.70	13.30	25.80	8.00	536.00	--	--	54.50	--	--	33.20	42.20
ACSSB028	RI	0 - 5	12,800.00	--	1.10	64.60	--	0.35	43.50	15.20	41.40	9.30	517.00	--	--	85.40	--	0.17	51.70	125.00
	RI	2.5 - 3	18,100.00	--	5.60	119.00	0.29	--	58.60	20.60	87.70	16.50	753.00	--	1.80	101.00	--	0.23	98.70	101.00
ACSSB029	RI	0 - 5	11,700.00	--	4.80	135.00	0.30	--	31.50	15.00	31.80	10.30	567.00	--	--	51.10	--	0.14	53.50	63.70
ACSSB030	RI	0 - 5	13,200.00	--	5.20	143.00	0.38	--	30.30	13.80	33.80	10.00	519.00	--	--	48.70	--	0.21	53.10	69.10
	RI	3 - 3.5	11,400.00	--	2.00	62.00	0.13	--	34.10	15.10	44.30	9.40	388.00	--	1.10	59.00	--	0.14	47.60	78.30
ACSSB031	RI	0 - 5	15,000.00	--	5.70	153.00	0.40	--	35.40	15.80	38.40	15.40	646.00	--	--	54.10	--	0.14	62.90	81.20
ACSSB036	RI	0 - 5	11,100.00	0.74	4.40	104.00	0.31	0.45	52.00	11.60	21.60	157.00	428.00	--	--	17.90	--	--	40.10	86.00
ACSSB037	RI	0 - 5	16,000.00	0.76	6.30	106.00	0.43	1.10	29.00	8.60	25.50	52.20	273.00	--	--	20.30	--	--	48.20	156.00
ACSSB038	RI	0 - 5	16,700.00	0.71	6.50	177.00	0.58	0.62	32.80	12.70	42.30	44.40	380.00	--	--	33.50	0.82	--	54.60	114.00
ACSSB039	RI	0 - 5	11,200.00	1.30	6.30	134.00	0.34	2.40	47.40	10.40	63.40	225.00	324.00	0.24	1.50	33.30	--	--	46.00	200.00
ACSSB040	RI	0 - 5	8,440.00	0.70	3.90	114.00	0.24	0.65	25.00	18.50	29.90	62.30	602.00	--	--	37.00	--	--	39.80	129.00
ACSSB041	RI	0 - 5	12,600.00	0.73	4.40	144.00	0.32	--	44.10	18.20	37.30	6.80	690.00	--	--	68.60	--	--	63.20	55.80
S12-01	SWMU	5 - 6	16,700.00	0.80	--	390.00	--	--	48.90	18.70	49.70	4.40	590.00	--	--	69.90	--	1.30	73.30	57.10
	SWMU	11 - 12	16,800.00	0.97	--	73.80	--	--	65.50	17.60	334.00	3.30	538.00	--	--	68.20	--	1.90	64.50	52.60
	SWMU	15 - 15.5	12,700.00	0.59	--	62.00	--	--	41.30	13.50	44.30	2.90	409.00	--	--	39.60	--	1.10	51.90	43.60
S12-02	SWMU	5 - 6	18,000.00	--	5.20	193.00	--	--	55.70	21.50	55.30	8.60	771.00	0.08	--	165.00	--	1.20	67.10	69.50
	SWMU	10 - 11	14,200.00	--	3.30	124.00	--	--	49.60	18.30	48.30	5.80	711.00	--	--	93.40	--	1.00	61.40	61.60
S12-03	SWMU	5 - 6	20,500.00	0.72	--	128.00	--	--	52.30	16.00	46.00	7.10	557.00	--	--	63.30	--	1.30	66.80	56.40
	SWMU	10 - 11	15,500.00	1.00	4.80	105.00	--	--	52.50	16.40	50.20	4.50	759.00	--	--	74.60	--	2.20	67.70	60.70
	SWMU	15 - 16	14,700.00	0.78	4.70	1,320.00	--	0.50	45.70	15.60	57.10	6.60	12,100.00	--	--	109.00	--	15.60	67.10	79.70

Concentrations shown in **bold** exceed the residential PRG

Concentrations of calcium, iron, magnesium, potassium, and sodium are not shown because they are common soil minerals, do not have PRGs, and are not expected to be the result of site activities. Appendix J includes a complete listing of the metals results.

TABLE 6-8

SUMMARY OF DETECTED ORGANICS IN GROUNDWATER  
 SITE 17 - BUILDING IA-24  
 INLAND AREA REMEDIAL INVESTIGATION  
 NWS CONCORD

Sample Location	Investigation	Bis(2-ethylhexyl)phthalate 5/95 (µg/L)	Diesel 9/95 (mg/L)
Tap Water PRGs (µg/L)		4.80	NE
ACSMW010	RI	<b>60.00</b>	--
ACSMW011	RI	--	--
ACSMW012	RI	<b>55.00</b>	--
ACSMW013	RI	--	--
ACSMW014	RI	--	0.06

NE - Not Established

Concentrations shown in **bold** exceed the tap water PRG

Appendix J contains full analytical tables which include the date sampled, sample with nondetected concentrations, and detection limits.

TABLE 6-9

**SUMMARY OF DETECTED METALS IN GROUNDWATER**  
**SITE 17 - BUILDING IA-24**  
**INLAND AREA REMEDIAL INVESTIGATION**  
**NWS CONCORD**

Sample Location	Investigation	Aluminum 5/95	Aluminum 9/95	Barium 5/95	Barium 9/95	Chromium 5/95	Chromium 9/95	Manganese 5/95	Manganese 9/95	Nickel 5/95	Nickel 9/95	Selenium 5/95	Selenium 9/95	Vanadium 5/95	Vanadium 9/95
Tap Water PRGs (µg/L)		37,000	37,000	2,600	2,600	37,000	37,000	1,700	1,700	730	730	180	180	260	260
ACSMW010	RI	150	--	93	128	--	--	9	--	--	--	--	--	5	5
ACSMW011	RI	477	309	102	113	4	3	22	14	3	--	--	--	5	5
ACSMW012	RI	479	--	90	103	--	--	34	--	--	--	--	5	5	4
ACSMW013	RI	396	--	9	6	7	3	13	15	3	--	--	--	3	4
ACSMW014	RI	--	--	77	102	--	--	4	--	--	--	--	4	4	4

Concentrations of calcium, iron, magnesium, potassium, and sodium are not shown because they are common soil minerals, do not have PRGs, and are not expected to be the result of site activities. Appendix J includes a complete listing of the metals results.

## **7.0 RESULTS OF THE RI/FS AT BUILDING 7SH5 (SITE 22)**

This section presents the results of the RI at Building 7SH5, Site 22. Building 7SH5 has been used as a missile wing and fin repair facility. The objective of the RI at Site 22 is to evaluate the nature and extent of chemicals present in soils and groundwater at the site as a result of past disposal of cleaners, paints, and solvents used in repair and maintenance conducted at Building 7SH5. Because TPH components were detected in soils collected during the SI, the RI also investigated the effects of a diesel UST and product piping at the site. The results of soil sampling at Building 7SH5 conducted as part of the SWMU investigation are also presented in this section.

### **7.1 PHYSICAL DESCRIPTION AND PAST OPERATIONS**

Building 7SH5 is located along the southwest portion of the base (Figure 1-3). The building was formerly a missile wing and fin repair facility, which involved paint stripping, cleaning, and repainting missile wings and fins. Missile repair required the use of acetone, trichloroethane, methyl ethyl ketone, chloroethane, and several types of paint thinners. The quantity of wastes generated from these activities was probably less than 100 gallons per year. Building 7SH5 (Figure 7-1) is currently used for manufacturing mobile laboratories to be used during EOD activities. Until 1978, the Tidal Area Landfill (Site 1) reportedly received all wastes from Building 7SH5. Since 1978, wastes have been disposed of off base.

During the IAS there were allegations that paints, oil, and solvents were disposed in a 24-inch-deep earthen pit or into a nearby drainage ditch near Building 7SH5 (E&E 1983). The suspected disposal pit was reportedly backfilled. IT Corp. identified the parking lot near the southwest corner of Building 7SH5, where a section of the pavement is missing, as the possible location of the pit (IT Corp. 1989) (Figure 7-1); however, this location was later identified, following the RI, as a possible excavation for a water line repair. The findings of the RI in this excavated area are discussed further in Sections 7.3 and 7.5. The drainage ditch is located along the southeast and southwest sides of the building (Figure 7-1).



## **7.2 PHYSICAL CHARACTERISTICS**

The following section presents the physical setting, geology, and hydrogeology for Site 22.

### **7.2.1 Physical Setting**

Site 22 is located in the western area of NWS Concord on the relatively flat (1 percent slope) flood plain of Seal Creek (Figure 1-3). The surrounding area consists of an array of ammunition magazines connected by a series of parallel roads and railroad spurs. Five hundred feet to the southwest is the NWS Concord boundary and Concord High School. Building 7SH5 is set on a low, manmade rise that facilitates loading and unloading rail cars from the building's northeast side (Figure 7-1). The area immediately around the building slopes to the southwest. Surface water draining from the site is intercepted by a drainage channel parallel to Seventeenth Street, and flows from the site to the northwest. A short drainage channel to the southeast of Building 7SH5 also drains into the main channel.

### **7.2.2 Geology**

Site 22 is located along the southern boundary of the Inland Area, within the alluvial slope of Los Medanos Hills, approximately 2,500 feet from the range front. Dibblee mapped the area as underlain by Quaternary young alluvium (Dibblee 1980a, 1981). The transect for a cross section constructed from boring logs is shown on Figure 7-2. The cross section is shown on Figure 7-3. Soil borings drilled at the site in May 1995 reveal that the site is generally underlain by clay, silty clay, clayey sand, and intermittent gravel from approximately 0 to 10 feet bgs. Exceptions to this general shallow depth characterization are in the approximate center of the site, where well borings reveal sand with clay and cobbles in the top 5 feet and in the northwest portion of the site. Geoprobe borings in this area show that silt and sandy silt are predominant. The 10- to 25-foot zone is generally composed of clays and sandy, silty clays, except in the northwest portion, which is made up of sandy silt from 10 to 16 feet bgs. A sandy, gravelly clay is encountered at approximately 25 feet below the central portion of the site. The soil boring logs for Site 22 are presented in Appendix B.

### 7.2.3 Hydrogeology

Hydrogeologic information for Site 22 was collected from temporary wells 7SHSB010, 7SHSB011, and 7SHSB012 installed in May 1995. Groundwater was first encountered in these borings in sandy-gravelly clays at approximately 25 feet bgs. The water level rose slightly in 7SHSB010; however, due to the clayey nature of the soils, it is unclear whether this indicates confined groundwater conditions or merely slow recharge from low permeability soils. The deeper sand/gravel water-bearing unit observed elsewhere at the Inland Area sites was not encountered at Site 22. Based on static water levels, the elevation of the potentiometric surface beneath the site ranges in elevation from approximately 137 to 138 feet msl. Groundwater flows to the west-northwest at a gradient of approximately 0.0175 (Figure 7-2). Groundwater measurements at Site 22 are included with the groundwater sampling forms presented as Appendix E.

The vertical permeabilities of the water-bearing zone, in which temporary wells 7SHSB610 through 7SHSB612 were screened, were assessed from geotechnical samples collected during borehole drilling. The vertical permeabilities calculated from these samples range from  $1.00\text{E-}07$  cm/sec to  $9.00\text{E-}07$  cm/sec. The geotechnical laboratory reports are presented in Appendix D, with a summary of the results presented in Table 7-1.

## 7.3 RESULTS OF PREVIOUS INVESTIGATIONS

**Initial Assessment Study.** A visual inspection of the site was conducted during the IAS. No visible environmental impact was noted during the inspection (E&E 1983). The IAS eliminated this site from consideration because of the small quantity of wastes that might be present. However, due to changes in law since the IAS (that is, CERCLA and SARA) and the absence of records on the disposal activities and pit abandonment, this site was included in the SI to evaluate whether it poses an environmental or health risk.

**Site Investigation.** The investigation at Site 22 included collecting and analyzing depth-specific soil samples from three soil borings within the suspected backfilled pit and collecting and analyzing one composite surface soil sample from the bottom of the drainage ditch. The three soil borings within the backfilled pit were drilled to a depth of 4 feet bgs (Figure 7-4). The top 2 feet contained fill material

consisting of cobbles and asphalt; below the fill material was silty and clayey sands and gravels. It is not known if the sand and clay is additional fill or native material. Three surface soil samples were also collected from the ditch parallel and adjacent to Seventeenth Street (Figure 7-4). The three soil samples from the ditch were composited at the laboratory into one sample for chemical analysis. The soil samples were analyzed for VOCs, SVOCs, metals, tributyltin (TBT), and TPH.

Two soil samples were collected from each of the three soil borings at depths of approximately 2 and 4 feet bgs. The soil sample collected from the 4.0-foot depth from boring SB-1 contained TPH-D at a concentration of 14.6 mg/kg (Figure 7-5). The sample collected from the 2-foot depth in the same soil boring did not contain any TPH-D. The majority of the metals in soil samples collected from the pit were not detected at concentrations greater than the reference levels of the AM/3SD. The only metals for which concentrations were greater than the 95/95 TI reference levels were arsenic (16.7 mg/kg), copper (332 mg/kg), lead (60.7 mg/kg), and mercury (1.10 mg/kg and 0.85 mg/kg); these levels of metals may be present in the soil as a result of site activity (Figure 7-6). The AM/3SD and 95/95 TI values were used in the SI as benchmarks for metals results; however, the RI data will be compared to ambient (ambient) concentrations of metals developed for the site, and to PRGs. The results of the SI sampling at the suspected disposal pit did not indicate that the pit was used for disposal of paints, oils, or solvents; however, it was not certain if the sampling depth exceeded the excavation depth, or whether the samples were collected from relatively clean backfill material. TPH-D detected in the soil samples may have been the result of leaking fuel oil piping that is located near the suspected disposal pit (Figure 7-5).

The composited soil sample from the ditch contained TPH-D, bis(2-ethylhexyl)phthalate, and toluene at concentrations of 9.23, 1.1, and 13 mg/kg, respectively. Bis(2-ethylhexyl)phthalate is a plasticizer that is typically added to polymers to impart flexibility. It is not unreasonable to detect this compound, especially within a surface drainage ditch, near industrial or military operations. No other VOCs or SVOCs were detected. Arsenic, detected at a concentration of 33 mg/kg, was the only metal from the composited ditch sample that exceeded the reference level for metals.

Minor concentrations of acetone, toluene, and methylene chloride were detected in some of the soil samples from the pit and the ditch (Figure 7-5). These compounds are common laboratory contaminants, and the methylene chloride detected may be a result of the contaminated deionized water used in the field. As explained in the SI report, the laboratory used old methylene chloride bottles for deionized

water sent to the field site. Only some of the SI samples from Site 22 were potentially affected before this practice was stopped.

**UST Investigation.** In September 1993, HLA conducted an investigation of the soil around the 1,000-gallon diesel fuel UST located along the southwest side of Building 7SH5. One boring was drilled at the southern corner of the UST. Samples were collected at depths of 4.5, 8, and 16 feet bgs and were analyzed for TPH-D and SVOCs. TPH-D was detected in the samples collected at depths of 4.5 feet bgs (7,700 mg/kg) and 8 feet bgs (1,600 mg/kg). The following SVOCs were detected in the sample collected at 4.5 feet bgs: acenaphthene (1,000 µg/kg), fluorene (2,400 µg/kg), 2-methyl-naphthalene (5,500 µg/kg), and naphthalene (4,600 µg/kg). Naphthalene was detected at 700 mg/kg in the sample collected at 8 feet bgs. The UST was removed from the site in 1997.

#### **7.4 REMEDIAL INVESTIGATION FIELD ACTIVITIES**

Soil and groundwater were sampled at Site 22 to evaluate the alleged disposal of paint wastes and solvents into a suspected disposal pit on the southeast side of Building 7SH5, and the effects of an UST and product piping (Figure 7-1). The samples were collected to assess whether these past site activities have affected environmental media at the site. The drainage channels around Building 7SH5 were sampled to assess whether contaminants are being transported off site. As part of the SWMU investigation, soil was sampled in the area of the septic tanks and leach field (samples 522-01 to -04) to evaluate whether soils at the site have been contaminated by effluent from the building's sanitary system.

To evaluate the spatial extent of contaminants at the site, the site has been divided into five areas based on past and present site activities and drainage features: (1) the suspected solvent waste disposal pit, (2) the UST fill pipe and product piping, (3) the site drainage channels, (4) an area 200 feet southwest of Building 7SH5, where soil samples were collected to assess ambient metals concentrations at the site, and (5) the area of the septic tank and leach field.

##### **7.4.1 Utility Locating and Geophysical Survey**

Site reconnaissance consisted of a visual inspection of sampling locations, a biological/ecological clearance, and a utility clearance, the latter conducted by NWS Concord personnel and representatives of

the concerned utilities. The utility clearance also identified the depth of the UST piping so that the samples collected adjacent to the UST piping could be sampled at the same depth.

#### **7.4.2 Pit Excavation**

Diagrams showing the excavation of the suspected disposal pit are included in Appendix C. Soil samples were collected from native soils in the suspected excavation pit after the fill material overburden was removed. An irregular area with maximum dimensions of 18 feet per side was excavated to a depth of 5 feet bgs. Twelve samples, from six locations within the pit, 7SHTP001A through 7SHTP001F, were collected from the floor of the excavation, at depths ranging from 1.0 to 5.5 feet bgs, as the excavation was deepened. The samples were analyzed for VOCs, SVOCs, TPH-E, and metals. No soil staining was observed in the excavation and no vapors were detected with the PID, so the excavation was backfilled with the excavated soil once the samples were collected.

#### **7.4.3 Surface Soil Sampling**

Five surface soil samples were collected from borings 7SHSB015, and 7SHSB024 through 7SHSB027, located in the drainage ditches bordering the southeast and southwest sides of the site (Figure 7-7). One sample was collected from boring 7SHSB015 at a depth of 3 feet bgs. These are areas where storm runoff may collect. The samples were analyzed for SVOCs, TPH-E, and metals.

#### **7.4.4 Geoprobe Borings**

Nine shallow Geoprobe soil borings, 7SHSB001 through 7SHSB009, were drilled at intervals of approximately 20 feet along the length of the piping from the fill pipe to the UST. The fill pipe is located at the east corner of Building 7SH5 and the UST is located on the southwest side of the building (Figure 7-7). Soil samples were collected at the depth of the fuel piping, which ranged from the surface to 3.5 feet bgs. The samples were analyzed for VOCs, SVOCs, and TPH-E.

Twelve soil samples were collected from ambient Geoprobe borings. As discussed in Appendix A, the metal concentrations from these samples were used to determine ambient metal concentrations. Soil samples were collected at the surface and at 7 feet bgs from two soil borings, 7SHSB013 and 7SHSB014,

located 50 feet southeast of Building 7SH5 and at a slightly higher elevation than the remainder of the site (Figure 7-7). These samples were analyzed for metals. Soil samples were also collected at the surface and at a depth of 10 feet bgs from four soil borings, 7SHSB020 through 7SHSB023, located on a low rise across Seventeenth Street from the site. These samples were analyzed for metals and pH.

#### **7.4.5 Subsurface Borings**

Three deep soil borings, 7SHSB010 through 7SHSB012, were drilled by West Hazmat Drilling Corporation of Newark, California (California Well Driller C57 License #554974), using a hollow stem auger drill rig in order to collect soil and grab groundwater samples adjacent to the UST piping at the UST fill pipe; and at locations along the piping 45 feet and 100 feet from the fill pipe. Two soil samples were collected from a depth of 10 feet bgs from 7SHSB010 and 7SHSB012 and at a depth of 20 feet bgs from 7SHSB010. The samples were analyzed for VOCs, SVOCs, and TPH-E. A soil sample from each soil boring was collected at the water-bearing zone and analyzed for TOC and geotechnical parameters. Temporary wells were installed in these boreholes for the collection of groundwater samples. The temporary monitoring wells were constructed with 4-inch diameter Schedule 40 PVC well casing. Wells were screened with 0.010-inch machine slotted casing. A filter pack consisting of No. 2/16 Monterey Sand was placed 1 to 2 feet above the top of the screened interval. The temporary monitoring wells were then developed and grab groundwater samples were collected and analyzed for VOCs, SVOCs, and TPH-E. Groundwater sampling forms are included in Appendix E. Soil borings and well construction diagrams are included in Appendix G. Well development records are provided in Appendix H. The temporary wells were removed upon completion of groundwater sampling. The boreholes were overdrilled and grouted to surface according to Contra Costa County standards.

Four soil borings, S52-01 through S52-04, were drilled in the area of the septic tank and leach lines as part of the SWMU investigation (Figure 7-7). Three samples were collected from both borings S52-01 and S52-02 at depths up to 16 feet bgs. Two samples were collected from both borings S52-03 and S52-04 at depths up to 4 feet bgs. The samples were analyzed for VOCs, SVOCs, and metals.

#### **7.4.6 Groundwater Sampling**

Three grab groundwater samples were collected from the boreholes of 7SHSB010 through 7SHSB012 and were analyzed for VOCs, SVOCs, and TPH-E. Groundwater sampling forms are included in Appendix E.

#### **7.4.7 Summary of Quality Assurance/Quality Control Field Procedures**

Field QA/QC sampling conducted during the field effort at Site 22 consisted of the collection of field duplicates, referee duplicates, field blanks, equipment rinsates, and trip blanks in accordance with the FSP (PRC/Montgomery Watson, 1995b). The results of these QA/QC samples are discussed in the QCSR (Appendix I). Field equipment was decontaminated in accordance with the procedures outlined in the FSP. Field instruments used during the field effort were calibrated and maintained in accordance with the QAPjP (PRC/Montgomery Watson 1995c). Borings and samples were documented in accordance with the WP and the FSP.

#### **7.4.8 Deviations from Proposed Investigation Approach**

Deep soil borings were drilled adjacent to the UST fill pipe, adjacent to the suspected disposal pit, and along the UST piping midway between these points. The FSP called for the deep borings to be located at the three points where TPH concentrations in the UST piping soil samples were the highest; however, because of the distribution of the TPH results (clustered near the UST fill pipe, as described in Section 7.5.2.1) and the presence of overhead utilities above the piping samples with other relatively elevated TPH concentrations, the locations of the borings were changed.

Soil samples were collected at the surface and at a depth of 10 feet bgs from four soil borings, 7SHSB020 through 7SHSB023, to more accurately characterize ambient metals concentrations in the area of the site. These additional ambient borings were not specified in the work plan but were collected to increase the size of the data set used to calculate the ambient metals concentration.

## **7.5 CHEMICAL CHARACTERIZATION**

This section presents the results of chemical analyses for soil and groundwater samples collected at Site 22. Soil and groundwater samples collected during the RI at Site 22 were submitted for the laboratory analyses described in Section 7.4 above and as presented in Tables 7-2 and 7-3. The analytical results of sampling are presented in Appendix J.

### **7.5.1 Results of Soil Sample Analyses**

This section presents the significant results of the soil sampling effort at Site 22. Soil samples were collected from Geoprobe borings, deep borings, and the ground surface at the locations described in Section 7.5. The results of sampling are compared to the PRGs established for residential soils (EPA 1995; Appendix L). The soil results are also compared to TTLC values defined in Title 22 of the California Code of Regulations. TTLC values are used to categorize waste. If concentrations exceed the TTLC values, then the waste is defined to exhibit the characteristic of toxicity. In this RI, the TTLC values are not used to characterize waste, but instead are used to compare to soil concentrations to locate any hot spots (areas of unusually high concentrations). The chemicals with concentrations exceeding these criteria are the only chemicals discussed in the following sections, and these chemicals are carried into the HHRA. There are no established PRGs for TPH constituents.

#### **7.5.1.1 Organic Compounds in Soils**

No organic compounds were detected in the soil samples collected at the site at concentrations exceeding TTLC values.

No VOCs were detected at concentrations greater than PRGs, however, TCE was detected in sample 7SHBSB010, collected at a depth of 20 feet bgs (Table 7-4). As described in Section 7.5.3, the origin of TCE in soil at this depth is likely to be groundwater rather than from the surface in the area of the boring.

No SVOCs were detected in soil samples collected at the site at concentrations exceeding PRG values (Table 7-5). The SVOCs 2-methylnaphthalene and naphthalene were detected in surface sample 7SHSB001, collected adjacent to the UST fill pipe. Eight low-level SVOCs were detected in drainage



ditch surface sample 7SHSB026. No SVOCs were detected in the suspected disposal pit except fluoranthene.

TPH detections in Site 22 soils are shown on Figure 7-8. Elevated concentrations of organic compounds were detected in the soil sample collected adjacent to the UST fill pipe (7SHSB001, 0.25 to 1.25 feet bgs), where TPH-D and TPH-motor oil were found at concentrations of 35,000 and 4,300 mg/kg, respectively (Table 7-6). TPH-D and TPH-motor oil were detected at concentrations of 370 and 160 mg/kg, respectively, in fuel piping sample 7SHSB002 (0.25 to 1.25 feet bgs), located 40 feet from the fill pipe. TPH in sample 7SHSB002 may be the result of migration of fuel along the piping trench. The 10- to 10.5-foot-bgs sample collected adjacent to the suspected disposal pit (7SHSB012) contained TPH-D at a concentration of 500 mg/kg. No other UST piping samples contained TPH-D. TPH-motor oil was detected in three additional samples collected along the fuel piping at concentrations up to 32 mg/kg in surface sample 7SHSB005. TPH-motor oil was detected in drainage ditch surface samples 7SHSB015 and 7SHSB024 through 7SHSB027 at concentrations up to 200 mg/kg (7SHSB024) and in the majority of the RI soil samples collected from the suspected disposal pit at concentrations up to 250 mg/kg (7SHTP001E, 1.0 foot bgs).

#### **7.5.1.2 Inorganic Compounds in Soils**

The ambient metal concentrations for Site 22 were calculated from metal concentrations detected in ambient soil samples (Appendix A). Inorganic compounds detected in Site 22 soils at concentrations exceeding PRG values and arsenic detections exceeding ambient levels are shown on Figure 7-9. Metals detected at concentrations exceeding PRG values in soils collected at the site were arsenic, beryllium, and lead (Table 7-7). No metals were detected in soil samples collected at the site at concentrations exceeding TTLC values. Arsenic was detected at concentrations exceeding the PRG value in the majority of the samples collected at Site 22; however, site ambient concentrations of arsenic greatly exceed the PRG value (15 mg/kg compared to 0.38 mg/kg), indicating that arsenic concentrations found in the samples are probably indigenous to the site. Arsenic concentrations exceeded ambient concentrations in several soil samples; these results are discussed below. For beryllium and lead, detections greater than the PRG are also greater than ambient values. The distribution of arsenic, beryllium, and lead in soil samples collected at the site is discussed below.

## **Arsenic**

Soil collected from 14 sampling locations contained arsenic at concentrations exceeding the ambient value of 15 mg/kg. Arsenic was detected at concentrations up to 250 mg/kg (ambient sample 7SHSB022, 10.0 to 10.5 feet bgs). For soil borings with samples collected at surface and at depth, arsenic concentrations in the surface samples were frequently one order of magnitude greater than the concentrations in the samples collected at depth (Appendix J), which may indicate an anthropogenic source. However, the presence of elevated arsenic concentrations in surface samples collected at the site is inconsistent with known past activities. Additionally, the soil borings located across the road adjacent to the site were used to calculate ambient values and had a similar pattern of arsenic distribution. This result indicates that site activities are not contributing to the arsenic in the soil.

## **Beryllium**

Beryllium was detected in ambient surface sample 7SHSB014 at a concentration of 0.16 mg/kg and in three disposal pit samples, at concentrations ranging from 0.17 to 0.29 mg/kg, which exceed the PRG value of 0.14 mg/kg. Concentrations of beryllium in two additional samples collected from the suspected disposal pit during the RI exceeded the ambient concentration of 0.12 mg/kg. Beryllium was not detected in any other samples collected from the site. Beryllium has been used for aerospace structures and in internal guidance systems (Merck & Co., Inc. 1983) and may be present in the soils of the suspected disposal pit as a result of missile repair.

## **Lead**

Lead was detected in SWMU investigation surface sample S52-03 at a concentration of 165 mg/kg, which exceeds the PRG value of 130 mg/kg. Lead was also detected at concentrations exceeding the site ambient concentration of 32 mg/kg in surface samples from ambient boring 7SHSB022, drainage channel boring 7SHSB024, and in a sample collected at a depth of 4 feet from the suspected disposal pit.

## 7.5.2

### Results of Groundwater Analyses

Organic compounds detected in Site 22 grab groundwater samples at concentrations exceeding PRG values, as well as all TPH detections, are shown on Figure 7-10. This section presents the significant results of the groundwater sampling effort at Site 22. Grab groundwater samples were collected from deep borings at the locations described in Section 7.4. The results of groundwater sampling are compared to the PRGs established for drinking water (EPA 1995; Appendix L). There are no established PRGs for TPH constituents. The RI grab groundwater samples at this site were not analyzed for metals.

TCE was detected in the groundwater sample collected from boring 7SHSB010 at a concentration of 27 µg/L, which exceeds the PRG value of 1.6 µg/L (Table 7-8). Boring 7SHSB010 was drilled adjacent to the UST fill pipe (Figure 7-7). Boring 7SHSB011 was drilled adjacent to the fuel piping, 45 feet from the fill pipe. Boring 7SHSB012 was drilled approximately 100 linear feet from the fill pipe, adjacent to the fuel piping and the suspected disposal pit. No VOCs were detected in soil samples collected at these boreholes, except TCE, which was detected at a concentration of 0.001 mg/kg in the soil sample collected at boring 7SHSB010 at a depth of 20 feet bgs. The TCE in this soil sample is probably the result of contact with, or diffusion from, TCE in the groundwater. Groundwater was measured in the borehole at a depth of 26 feet bgs. Because no VOCs other than xylenes were detected in the shallow soils, the VOCs in the groundwater samples collected in the boreholes are not likely to have originated at the surface in the area of the boreholes, but rather migrated from other areas of the site or from off site.

No SVOCs were detected in the groundwater samples collected during the RI.

TPH-motor oil was detected in the groundwater samples collected from borings 7SHSB010, 7SHSB011, and 7SHSB012 at concentrations of 0.6, 0.5, and 0.4 mg/L, respectively (Table 7-8). Motor oil was detected at a concentration of 11 mg/kg in the soil sample collected from a depth of 10.0 to 10.5 feet bgs in boring 7SHSB010, and TPH-D was detected at a concentration of 500 mg/kg in the soil sample collected from a depth of 10.0 to 10.5 feet bgs in boring 7SHSB012.

### **7.5.3 Summary of Chemical Characterization**

As stated in Section 7.4, the site was divided into five study areas to assess the spatial extent of chemicals. This section summarizes the organic and inorganic chemicals detected within the four study areas associated with site activities and site drainage, and in the fifth area, where ambient soil samples were collected to calculate ambient metal concentrations. A summary of analytical results relating to the site as a whole is presented prior to the summary of the analytical results from the study areas.

Arsenic was detected in all soil samples collected from the site during the RI and SWMU investigations at concentrations exceeding the PRG value. Ambient concentrations of arsenic at the site exceed PRGs, indicating that relatively elevated arsenic levels are indigenous to the site; however, surface concentrations of arsenic are generally much higher than subsurface concentrations.

One groundwater sample collected from a temporary well during the RI contained TCE at a concentration of 27 µg/L, which exceeds the PRG value of 1.6 µg/L. TPH-motor oil was detected at concentrations ranging from 0.4 to 0.6 mg/L. VOCs in groundwater collected in the boreholes are not likely to have originated at the surface in the area of the boreholes, but rather migrated from other areas of the site, or from off site.

#### **Suspected Solvent Disposal Pit**

TPH-motor oil at concentrations up to 250 mg/kg was detected in soil samples collected from the suspected disposal pit.

Beryllium was detected in three disposal pit soil samples at concentrations exceeding the PRG and in two additional disposal pit soil samples at concentrations exceeding the ambient concentration, and may be the result of past activities at the site.

#### **UST Fill Pipe and Fuel Piping**

Elevated concentrations of organic compounds were detected in the surface soil sample collected adjacent to the UST fill pipe, where TPH-D, TPH-motor oil, and xylenes were detected at concentrations

of 35,000, 4,300, and 11 mg/kg, respectively. TPH-motor oil and TPH-D were detected at lower concentrations in soil samples collected along the fuel line near the fill pipe and the suspected disposal pit. Two SVOCs were detected in the fill pipe soil sample.

#### **Site Drainage Channels**

TPH-motor oil at concentrations up to 200 mg/kg was detected in soil samples collected from the west drainage ditch. SVOCs were detected in two drainage ditch surface soil samples.

#### **Septic Tank and Leachfield**

Metals were found in soil samples collected in the north part of the site (as part of the SWMU investigation) at generally lower concentrations than those that were collected from the central and southern areas of the site (as part of the RI). The result for lead in SWMU investigation sample S52-03 (cited in Section 7.5.1.2) was the only soil sample result from the SWMU investigation that exceeded the PRG or ambient values.

### **7.6 REVISED CONCEPTUAL SITE MODEL**

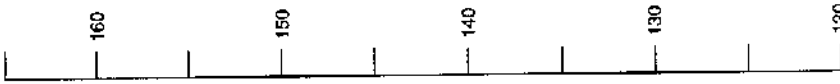
The conceptual site model was developed after the SI and is presented in the WP (PRC/Montgomery Watson 1995a). This conceptual site model has been updated to include the RI data. The model lists potential sources and COPCs identified in Section 7.5, and highlights the most likely migration routes (Figure 7-11). The model is used in conjunction with the results from the human health and ecological risk assessments and the fate and transport properties of the COPCs to assess site conditions and the need for remediation. Site 22 is located on a slight mound on the western portion of the Inland Area, with the building surrounded by a drainage channel 3 to 5 feet deep. The SI was originally conducted to evaluate the presence of paint and other maintenance wastes that were reportedly disposed of in a pit. The SI did not find any high concentrations of chemicals that would indicate disposal activities, but this conclusion was tentative because gravel and other apparent fill material made soil boring difficult. In addition, evaluating the possible presence of elevated levels of metals was complicated by the uncertain nature and source of the fill material itself. However, TPH-D detected in soil borings was considered to be present due to leaking UST piping that leads from the south end of the building to an UST located at the middle

of the west side of the building. Chemical migration routes include surface soil erosion with runoff to the drainage channel to the west of the building and leaching to groundwater. TPH-D, TCE, and metal constituents were detected in the grab groundwater samples. No nonaqueous phase liquid (NAPL) was observed in the three temporary wells. The wind transport pathway is not significant because TCE was the only VOC detected, and it was detected in groundwater and not in soil samples.

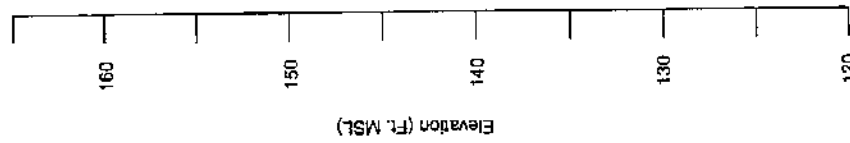
## Figures 7-1 and 7-2

These detailed station maps have been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.

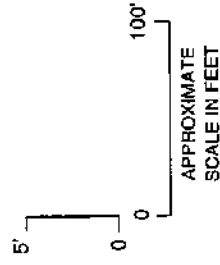
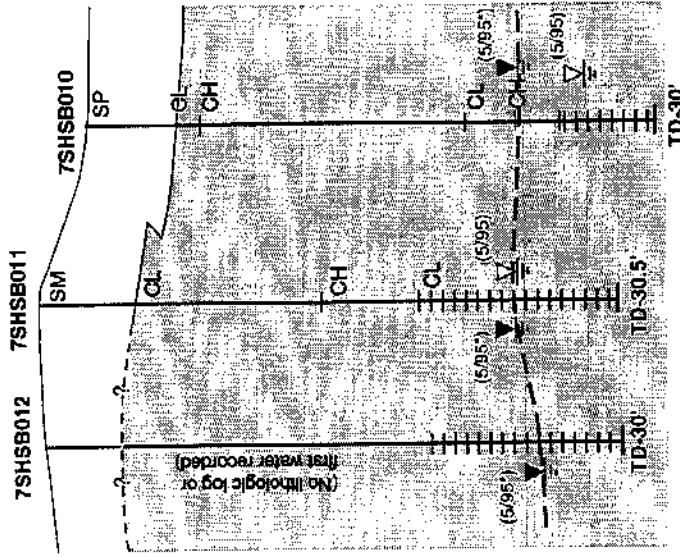
EAST  
H'



WEST  
H



Bend in Section



LEGEND

- Depth to First Encountered Groundwater (Date)
- Static Water Level (Date)
- Water Level Collected During Groundwater Sampling and Gauging Event
- Projected Potentiometric Surface
- Monitoring well screened interval
- Sand and Gravel
- Clay and Silt

NWS CONCORD - INLAND AREA  
CONCORD, CALIFORNIA

FIGURE 7-3  
SITE 22  
HYDROGEOLOGIC CROSS SECTION H-H'

SIZE	DATE	DWG NAME	REV
	06/05/96		1

06/96.CD



## Figures 7-4 - 7-10

These detailed station maps have been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.

TABLE 7-1

**REMEDIAL INVESTIGATION  
SUMMARY OF GEOTECHNICAL TESTING RESULTS  
SITE 22 - BUILDING 7SH5  
WPNSTA CONCORD**

Laboratory Identification	Soil Sample Location	Sample Interval (feet bgs)	Grain Size	USCS Symbol	Permeability (cm/sec)	Porosity (%)	Density lb/ft <sup>3</sup>	Specific Gravity	Moisture (%)
SH617	7SHSB010	25.5-26.0	Clay	~~	1.00E-07	49.32	86.6	2.74	34.9
SH621	7SHSB011	26.0-26.5	Clay and sand	CL-SC	1.00E-07	36.87	104.8	2.66	20.8
SH625	7SHSB012	25.0-25.5	Sandy clay	~~	9.00E-07	39.29	102.3	2.70	18.1

~~ - Information not provided by testing laboratory

TABLE 7-2

**SUMMARY OF SOIL ANALYSES, SITE 22**  
**INLAND AREA REMEDIAL INVESTIGATION**  
**NWS CONCORD**

Sample Location	Investigation	Matrix	Sample Depth	Organic Compounds					Inorganic Constituents						
				CLP SVOC	Low Level SVOC	TPH Extractable	VOCs	Oil/ Grease	Hex. Chromium	CLP Metals	Geophys. Param.	Grain Size	Percent Moisture	TOC	
7SHSB001	RI	Soil	.25 - 1.25	1		1	1								
7SHSB002	RI	Soil	.25 - 1.25	1		1	1								
7SHSB003	RI	Soil	1 - 1.5	1		1	1								
7SHSB004	RI	Soil	1 - 2	1		1	1								
7SHSB005	RI	Soil	0 - 1	1		1	1								
7SHSB006	RI	Soil	2 - 3	1		1	1								
7SHSB007	RI	Soil	2 - 3	1		1	1								
7SHSB008	RI	Soil	2.5 - 3.5	1		1	1								
7SHSB009	RI	Soil	2.5 - 3.5	1		1	1								
7SHSB010	RI	Soil	1 - 10.5	1		1	1								
	RI	Soil	2 - 20.5	1		1	1								
	RI	Soil	25.5 - 26									1	1		1
	RI	Soil	3 - 30.5	1		1	1								
7SHSB011	RI	Soil	1 - 10.5	1		1	1								
	RI	Soil	2 - 20.5	1		1	1								
	RI	Soil	26 - 26.5									1	1		1
	RI	Soil	3 - 30.5	1		1	1								
7SHSB012	RI	Soil	1 - 10.5	1		1	1								
	RI	Soil	2 - 20.5	1		1	1								
	RI	Soil	25 - 25.5									1	1		1
	RI	Soil	3 - 30.5	1		1	1								
7SHSB015	RI	Soil	0 - .5	1		1	1				1			1	
	RI	Soil	3 - 3.5	1		1	1		1		1				
7SHSB024	RI	Soil	0 - .5			1	1		1		1			1	
7SHSB025	RI	Soil	0 - .5			1	1				1			1	
7SHSB026	RI	Soil	0 - .5		1	1	1				1			1	
7SHSB027	RI	Soil	0 - .5		1	1	1				1			1	
7SHTP001A	RI	Soil	1 - 1	1		1	1				1				
	RI	Soil	4 - 4	1		1	1				1				
7SHTP001B	RI	Soil	5.5 - 5.5	1		1	1				1				
	RI	Soil	3 - 3	1		1	1				1				
7SHTP001C	RI	Soil	2 - 2	1		1	1				1				

TABLE 7-2

**SUMMARY OF SOIL ANALYSES, SITE 22  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD  
(CONTINUED)**

Sample Location	Investigation	Matrix	Sample Depth	Organic Compounds					Inorganic Constituents					
				CLP SVOC	Low Level SVOC	TPH Extractable	VOCs	Oil/ Grease	Hex. Chromium	CLP Metals	Geophys. Param.	Grain Size	Percent Moisture	TOC
7SHTP001D	RI	Soil	3 - 3	1		1	1			1				
	RI	Soil	5 - 5	1		1	1			1				
7SHTP001E	RI	Soil	1 - 1	1		1	1			1				
	RI	Soil	2 - 2	1		1	1			1				
	RI	Soil	5 - 5	1		1	1			1				
	RI	Soil	2 - 2	1		1	1			1				
7SHTP001F	RI	Soil	3 - 3	1		1	1			1				
	RI	Soil	5 - 6	1		1	1			1				
S52-01	SWMU	Soil	1 - 11	1		1	1			1				
	SWMU	Soil	15 - 16	1		1	1			1				
	SWMU	Soil	5 - 6	1		1	1			1				
S52-02	SWMU	Soil	1 - 11	1		1	1			1				
	SWMU	Soil	15 - 16	1		1	1			1				
	SWMU	Soil	0 - .5	1		1	1			1				
	SWMU	Soil	3.5 - 4	1		1	1			1				
S52-04	SWMU	Soil	0 - .5	1		1	1			1				
	SWMU	Soil	2 - 2.5	1		1	1			1				
<b>Total:</b>				42	2	36	39	10	3	28	3	3	5	3

**Notes:**

Section 3.0 tables list the analytical methods used and Appendix I, Quality Control Summary Report, describes quality assurance samples.

TABLE 7-3

**SUMMARY OF GROUNDWATER ANALYSES, SITE 22  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

Sample Location	Matrix	Investigation	Sample Date	Organic Compounds							Inorganic Constit.	Other Parameters			
				Aromatic Volatiles	Explos.	CLP SVOC	TPH Extract.	TPH Purge.	VOC	Metals		pH	TSS	TOC	Cond/ Hardness
7SHSB010	Groundwater (Grab)	RI	5/16/95			1	1		1						
7SHSB011	Groundwater (Grab)	RI	5/16/95			1	1		1						
7SHSB012	Groundwater (Grab)	RI	5/16/95			1	1		1						
Total:				0	0	3	3	0	3	0	0	0	0	0	0

## Notes:

Section 3.0 tables list the analytical methods used and Appendix I, Quality Control Summary Report, describes quality assurance samples.

Explos. - Explosive Compounds

TPH Extract. - Extractable total petroleum hydrocarbons

TPH Purge. - Purgeable total petroleum hydrocarbons

TSS - Total suspended solids

TOC - Total organic carbon

TABLE 7-4

SUMMARY OF DETECTED VOCs IN SOIL  
SITE 22 - BUILDING 7SH5  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD

Sample Location	Investigation	Sample Depth (ft bgs)	1,2-Dichloropropane	2-Butanone	4-Methyl-2-pentanone	Acetone	Carbon Disulfide	Chloroform	Toluene	Trichloroethene	Xylene (Total)
Residential PRGs (mg/kg)			0.31	7,100	770	2,100	7.5	0.25	790	3.2	320
Concentration (mg/kg)											
7SHSB001	RI	.25 - 1.25	--	--	--	--	--	--	--	--	11
7SHSB010	RI	20 - 20.5	--	--	--	--	--	--	--	0.001	--

NE - Not Established

Concentrations shown in **bold** exceed the residential PRG.

Appendix J contains full analytical tables which include the date sampled, samples with nondetected concentrations, and detection limits.

TABLE 7-5

**SUMMARY OF DETECTED SVOCs IN SOIL**  
**SITE 22 - BUILDING 7SH5**  
**INLAND AREA REMEDIAL INVESTIGATION**  
**NWS CONCORD**

Sample Location	Investigation	Sample Depth (ft bgs)	Concentration (mg/kg)														Total PAHs	
			Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Benzo(e)pyrene	Chrysene	Fluoranthene	Phenanthrene	Phenol	Pyrene	2-Methylnaphthalene	Naphthalene	High Molecular Weight PAHs	Low Molecular Weight PAHs	NE	NE	
Residential PRGs (mg/kg)			0.61	0.061	0.61	NE	6.1	2,600	NE	39,000	100	NE	240	NE	NE	NE		
7SHSB001	RI	.25 - 1.25	--	--	--	--	--	--	--	--	--	20	8.1	--	28.1	28.1		
7SHSB002	RI	.25 - 1.25	--	--	--	--	--	--	--	0.44	--	--	--	--	--	--		
7SHSB003	RI	1 - 1.5	--	--	--	--	--	--	--	0.38	--	--	--	--	--	--		
7SHSB004	RI	1 - 2	--	--	--	--	--	--	--	0.36	--	--	--	--	--	--		
7SHSB007	RI	2 - 3	--	--	--	--	--	--	--	0.21	--	--	--	--	--	--		
7SHSB009	RI	2.5 - 3.5	--	--	--	--	--	--	--	0.31	--	--	--	--	--	--		
7SHSB015	RI	0 - .5	--	--	--	--	--	--	--	--	0.22	--	--	0.22	--	0.22		
7SHSB026	RI	0 - .5	0.004	0.005	0.016	0.008	0.01	0.013	0.007	--	0.007	--	--	0.055	0.007	0.062		
7SHTP001A	RI	1 - 1	--	--	--	--	--	0.34	--	--	--	--	--	0.34	--	0.34		
S52-01	SWMU	5 - 6	--	--	--	--	--	--	--	0.92	--	--	--	--	--	--		
	SWMU	15 - 16	--	--	--	--	--	--	--	0.41	--	--	--	--	--	--		
S52-02	SWMU	5 - 6	--	--	--	--	--	--	--	1.2	--	--	--	--	--	--		
	SWMU	1 - 11	--	--	--	--	--	--	--	0.25	--	--	--	--	--	--		

NE - Not Established

Concentrations shown in **bold** exceed the residential PRG.

Appendix J contains full analytical tables which include the date sampled, samples with nondetected concentrations, and detection limits.

TABLE 7-6

**SUMMARY OF DETECTED TPH IN SOIL  
SITE 22 - BUILDING 7SH5  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

Sample Location	Investigation	Sample Depth (ft bgs)	Diesel	Motor Oil
Residential PRGs (mg/kg)			NE	NE
			Concentrations (mg/kg)	
7SHSB001	RI	.25 - 1.25	35,000	4,300
7SHSB002	RI	.25 - 1.25	370	160
7SHSB003	RI	1 - 1.5	--	14
7SHSB005	RI	0 - 1	--	32
7SHSB006	RI	2 - 3	--	29
7SHSB010	RI	10 - 10.5	--	11
7SHSB012	RI	10 - 10.5	500	--
7SHSB015	RI	0 - .5	--	84
7SHSB024	RI	0 - .5	--	200
7SHSB025	RI	0 - .5	--	37
7SHSB026	RI	0 - .5	--	41
7SHSB027	RI	0 - .5	--	29
7SHTP001A	RI	1 - 1	--	69
	RI	4 - 4	--	88
7SHTP001B	RI	3 - 3	--	32
7SHTP001C	RI	2 - 2	--	22
7SHTP001E	RI	1 - 1	--	250
	RI	2 - 2	--	220
7SHTP001F	RI	2 - 2	--	43
	RI	3 - 3	--	85

NE - Not Established



TABLE 7-7

**SUMMARY OF DETECTED METALS IN SOIL**  
**SITE 22 - BUILDING 7SH5**  
**INLAND AREA REMEDIAL INVESTIGATION**  
**NWS CONCORD**

Sample Location	Investigation	Sample Depth (ft bgs)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Nickel	Vanadium	Zinc
Residential PRGs (mg/kg)			77,000.00	31.00	0.38	5,300.00	0.14	9.00	77,000.00	4,600.00	2,800.00	130.00	3,200.00	23.00	150.00	540.00	23,000.00
Concentrations of Total Metals (mg/kg)																	
7SHSB015	RI	0 - 5	15,400.00	0.56	42.10	171.00	--	--	39.90	17.50	47.60	13.20	607.00	0.33	58.30	62.20	80.40
	RI	3 - 3.5	17,000.00	0.66	28.40	103.00	--	--	63.90	23.90	52.90	7.00	699.00	0.15	126.00	69.90	64.80
7SHSB024	RI	0 - 5	21,800.00	0.73	55.20	164.00	--	--	51.50	24.10	115.00	53.20	732.00	0.30	62.20	89.90	333.00
7SHSB025	RI	0 - 5	16,300	1.50	127.00	198.00	--	--	46.30	19.00	50.50	21.70	720.00	0.12	67.90	67.30	83.30
7SHSB026	RI	0 - 5	15,800.00	0.87	39.50	178.00	--	--	38.00	17.40	45.80	15.60	570.00	0.19	52.50	64.10	84.00
7SHSB027	RI	0 - 5	17,700.00	1.50	86.80	266.00	--	--	48.20	21.40	55.50	--	819.00	0.25	76.30	76.20	104.00
7SHTP001A	RI	1 - 1	11,500.00	--	13.60	101.00	0.17	--	25.30	15.10	39.70	13.80	421.00	0.24	29.00	42.50	52.80
	RI	4 - 4	15,100.00	--	31.90	121.00	--	0.18	29.90	31.70	47.90	45.20	704.00	0.10	41.70	55.70	159.00
	RI	5.5 - 5.5	22,000.00	0.65	6.60	256.00	--	0.23	58.30	22.40	61.80	11.90	944.00	0.08	93.80	71.90	88.50
7SHTP001B	RI	3 - 3	17,700.00	--	11.00	83.80	--	0.26	32.90	15.80	35.90	28.80	279.00	0.11	29.90	59.80	1,900.00
7SHTP001C	RI	2 - 2	16,200.00	--	20.50	78.10	0.29	--	37.40	19.20	49.40	20.60	428.00	0.37	35.00	54.20	61.80
7SHTP001D	RI	3 - 3	14,000.00	--	6.90	166.00	0.19	--	24.70	11.80	25.80	7.10	338.00	--	17.80	49.00	68.80
	RI	5 - 5	20,300.00	--	8.90	200.00	--	0.18	56.90	22.70	62.60	12.50	673.00	0.07	96.10	71.80	89.30
7SHTP001E	RI	1 - 1	18,500.00	--	15.10	101.00	--	0.22	34.80	19.50	58.00	20.50	586.00	0.49	35.20	64.20	78.60
	RI	2 - 2	21,300.00	--	8.80	22.80	--	--	29.40	23.60	77.40	11.40	499.00	0.63	22.70	80.00	53.70
	RI	5 - 5	16,600.00	--	5.90	203.00	--	0.22	47.00	19.20	53.70	10.00	746.00	0.08	81.90	60.80	75.10
7SHTP001F	RI	2 - 2	13,200.00	--	23.40	134.00	--	0.15	27.40	15.80	40.50	11.60	483.00	0.19	36.80	54.10	64.00
	RI	3 - 3	16,800.00	--	14.00	89.40	--	--	26.70	19.60	63.80	24.40	474.00	0.23	22.90	62.40	65.80
S52-01	SWMU	5 - 6	21,200.00	0.59	9.60	223.00	--	--	61.50	22.80	63.90	12.80	1,000.00	--	90.20	81.20	90.90
	SWMU	1 - 11	15,000.00	--	6.10	162.00	--	--	43.80	19.50	50.30	8.10	788.00	0.11	77.10	60.30	72.10
	SWMU	15 - 16	16,500.00	0.68	6.90	183.00	--	--	51.80	21.80	57.30	9.20	687.00	0.07	89.80	72.10	82.10
S52-02	SWMU	5 - 6	16,400.00	--	5.10	183.00	--	--	48.80	19.00	53.20	8.30	803.00	--	78.20	61.80	72.90
	SWMU	1 - 11	15,800.00	0.45	6.00	120.00	--	--	49.00	17.50	50.40	7.50	685.00	0.10	68.60	64.70	72.50
	SWMU	15 - 16	18,400.00	--	7.90	157.00	--	--	52.40	21.00	54.20	8.90	888.00	0.13	91.70	74.40	80.30
S52-03	SWMU	0 - 5	15,400.00	1.20	65.40	164.00	--	1.30	49.80	19.30	59.30	165.00	805.00	0.06	--	70.20	160.00
	SWMU	3.5 - 4	17,300.00	0.49	28.70	187.00	--	--	50.00	19.60	58.70	9.00	751.00	0.15	79.70	68.80	85.00
S52-04	SWMU	0 - 5	16,500.00	--	38.00	202.00	--	--	45.00	19.40	54.50	13.50	792.00	0.14	74.70	57.90	79.20
	SWMU	2 - 2.5	16,600.00	0.72	14.70	102.00	--	--	61.30	17.00	44.70	7.90	673.00	0.11	95.10	63.80	70.20

Concentrations shown in **bold** exceed the residential PRG

Concentrations of calcium, iron, magnesium, potassium, and sodium are not shown because they are common soil minerals, do not have PRGs, and are not expected to be the result of site activities. Appendix J includes a complete listing of the metals results.

TABLE 7-8

**SUMMARY OF DETECTED ORGANICS IN GROUNDWATER  
SITE 22 - BUILDING 7SH5  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

Sample Location	Investigation	1, 1, 1-Trichloroethane 5/95 (µg/L)	Trichloroethene 5/95 (µg/L)	Motor Oil 5/95 (µg/L)
Tap Water PRGs		790	1.6	NE
7SHSB010	RI	--	<b>27.00</b>	630
7SHSB011	RI	2.00	--	450
7SHSB012	RI	1.00	--	380

NE - Not Established

Concentrations shown in **bold** exceed the tap water PRG

Appendix J contains full analytical tables which include the date sampled, samples with nondetected concentrations, and detection limits.

## **8.0 RESULTS OF THE REMEDIAL INVESTIGATION AT THE PISTOL FIRING RANGE (SITE 24A)**

This section presents the results of the RI at the Pistol Firing Range, Site 24A. The Pistol Firing Range is active and has been in use since at least the mid-1960s. Although the site was investigated under the IR program, the site has since been removed from the IRP because of the site's active status. All future maintenance and environmental work at Site 24A will be conducted by NWS Concord personnel or their subcontractors. The objective of the RI at the Pistol Firing Range is to evaluate the nature and extent of metals present in firing range target berms and drainage features that are the result of past and present site activities.

### **8.1 PHYSICAL DESCRIPTION AND PAST OPERATIONS**

The Pistol Firing Range is located in Los Medanos Hills near Building IA-57, east of Kinne Boulevard at the end of a gravel road off the east end of Wilden Road (Figure 1-3). The intersection of Wilden Road and Kinne Boulevard is approximately 3.5 miles from the front gate of NWS Concord. The Pistol Firing Range has been an active range since at least the mid-1960s. An earthen berm constructed on the east side of the firing range serves as a protective backstop behind the target area (Figure 8-1). This berm is referred to as the target berm in this report. In the late 1970s or early 1980s, a project reportedly was undertaken to replace the original target berm. The removal of lead from the old berm was regarded as cost prohibitive, so the berm was capped with soil of unknown thickness to create the current berm.

The ammunition fired at the range varies from small-caliber to 50-caliber rounds. The target berm is the study area of this site because of potential metals contamination from the lead-centered, copper-jacketed projectiles that penetrate the berm. Soil samples previously were collected from the berm to quantify the metals concentrations in the soil from metal projectiles.

### **8.2 PHYSICAL CHARACTERISTICS**

The following section presents the physical setting and geology for Site 24A.

### **8.2.1 Physical Setting**

The Pistol Firing Range is an active site located 1,700 feet east of Kinne Boulevard near Building 1A-57 (Figure 1-3). The site is perched on a fairly steep slope in Los Medanos Hills, approximately 130 feet above the flood plain of Seal Creek. The firing range is surrounded by the natural hill slope to the north and east and by artificial protective berms to the south and west (Figure 8-1). Storm water in the firing range area flows into a drainage channel located along the base of the south berm. The storm water that collects in the channel flows west and off site via a small gully. A section of the abandoned Clayton Canal follows the contour of the hill slope approximately 800 feet west (downslope) of the site.

### **8.2.2 Geology**

The lithology that underlies Site 24A has been mapped as Tertiary age, weakly indurated, pebble conglomerate, sandstone, and claystone (Dibble 1980a,b,c; 1981). No subsurface hydrogeologic information is available for the immediate vicinity from previous investigations. The Clayton Fault has been mapped along the margin of Los Medanos Hills (Dibble 1980a,b,c; 1981) near Site 24A. As discussed in Section 2.5.2, the fault is considered potentially active (active within the last 25,000 years) by some geologists (Nelson 1993). However, the fault is not designated an Alquist-Priolo special studies zone, which studies fault-rupture hazards in California (California Department of Conservation, Division of Mines and Geology [DMG] 1992), nor has it been considered for investigation by DMG because it shows no evidence of surface rupture in the last 11,000 years (Hart 1993). Soil borings drilled in April and May 1995 reveal that the site is generally underlain by silt, clay, sand, and clayey sand from 1 to 8 feet bgs and clay and sand from 8 to 11 feet bgs. Soil boring logs for the RI at Site 24A are included in Appendix B. Geotechnical testing of drainage channel soil samples, located immediately north of the protective berm, indicates that surface soil in the area consists of clayey sand and sandy clay with vertical permeabilities of  $3.00\text{E-}07$  cm/sec and  $4.00\text{E-}07$  cm/sec, respectively. Surface soils in the area of PFRSB029, collected adjacent to the target berm, consist of silty sand with a vertical permeability of  $6.00\text{E-}04$  cm/sec. The geotechnical laboratory report is included in Appendix D. A summary of Site 24A geotechnical parameters is included in Table 8-1.

**Initial Assessment Study.** The IAS reported that although there was a significant amount of lead in the target berm, it was not a threat to groundwater because the berm was recapped and the lead was in an elemental metallic form. The IAS concluded that further investigation was unnecessary.

**Site Investigation.** The Navy continued investigations to quantify the metal concentrations in the soil. For the SI, the target berm was divided into three areas according to the expected concentration of metals from bullets entering the berm (Figure 8-2). This expectation was visually confirmed during SI field sampling. Area 3 is low on the slope and contained the most projectiles because it was directly behind the target area (Figure 8-2), while Area 1 is located to the left of the target area and Area 2 is located higher up on the slope from the main target area. Evidence of shotgun and 40-mm grenade use was found in Areas 2 and 3. The surface soils and subsurface soil samples collected from the berm were analyzed for metals.

The target berm soil consisted mostly of silty sands and sandy silts. Soil samples were collected from each sampling location at depths of 1, 2, and 3 feet bgs to determine the depth of ammunition-related chemicals that may have penetrated the berm. The samples were composited in the laboratory based on similar boring depth. No visible contact between a cover and the old berm was identified during the SI.

Projectiles (lead and copper) were not found in the soil borings deeper than the first foot into the target berm. Antimony (25.6 mg/kg), barium (712 mg/kg), cadmium (21.8 mg/kg), copper (71,700 mg/kg), lead (16,700 mg/kg), and zinc (7,490 mg/kg) were detected at concentrations greater than the AM/3SD, and some of these metals (cadmium, lead, copper, and zinc) may be elevated because of site activities (Figure 8-3). The AM/3SD was used in the SI as a benchmark for metals, however, the RI data will be compared to ambient concentrations of metals. In agreement with the results of the visual inspection, the concentrations of metals in the soil samples were lowest in Area 1 and greatest in Area 3. Soils in the berm contained elevated concentrations of various metals, and some of these metals are related to ammunition fragments. Antimony, cadmium, copper, lead, and zinc were found at elevated concentrations in samples from Area 3 and the surface sample from Area 2, indicating a possible correlation between the presence of ammunition fragments and the detection of these metals.

During the SI, the California Waste Extraction Test (WET) was performed on the samples if the detected concentrations of metal in soil were at least an order of magnitude greater than the soluble threshold limit concentration (STLC). Two original samples and one duplicate sample from Area 3, as well as one sample from Area 2, contained copper, lead, or zinc concentrations greater than one order of magnitude above the STLC criteria. The STLC values are 25 mg/L for copper, 5 mg/L for lead, and 250 mg/L for zinc. Of these three metals, lead was the only metal in the leachates from the four samples with concentrations exceeding the STLC.

No samples were collected from beneath the target berm to evaluate whether metals might be leaching to the groundwater beneath the site. The depth to groundwater at this site is unknown. Soil boring 02N01W16N (Department of Water Resources water well driller's report number 163194), located about 1.5 miles north and at an elevation of about 640 feet above msl, is the nearest borehole to the firing range. This borehole was drilled to about 170 feet above msl; however, groundwater was not encountered. The elevation of ground surface at Site 24A is about 285 feet above msl (Figure 8-1).

The primary migration pathway of potential concern for metals is storm water runoff from the target berm; this pathway was not addressed in the SI. Storm water runoff from the berm drains into a ditch along the range's southern boundary and moves off site to the west. At the west end of the range, runoff flows through a culvert under the firing range entrance road and then drains down the hillside into the abandoned Clayton Canal which runs between Sites 17 and 24A. The canal provided irrigation water to the area prior to the Navy purchasing the land. Water was supplied to Clayton Canal from Contra Costa Canal via a pump station area Willow Pass Road. The canal leads to Galindo Creek approximately 2 miles southwest of Site 24A at Denkinger Road and Clayton Road. Currently, no water is pumped into the canal. During the wet season, storm water may flow through the canal.

#### **8.4 REMEDIAL INVESTIGATION FIELD SAMPLING**

Soil was sampled at the Pistol Firing Range site to assess the nature and extent of metals present in the firing range berms and areas of runoff as a result of site activities. The drainage channel was sampled to assess to what degree metals in the target berm are being transported off site from storm water runoff. Samples collected at depth beneath the target berm were collected to assess whether metals are migrating down to the soil/bedrock interface. In addition, selected samples collected at the target berm were

submitted for SVOCs analysis because of an organic odor that was noticed during surface sample collection.

Based on site activities, topography, and drainage, sampling was conducted in three areas; (1) the target berm, which stops the projectiles that are fired at targets, (2) the drainage channel that begins at the firing berm and drains storm water from the site to the hillside, and (3) the south protective berm that is oriented parallel to the direction of fire, where soil sample results were collected to assess ambient metals concentrations at the site.

#### **8.4.1 Site Reconnaissance Activities**

Site reconnaissance consisted of a visual inspection of sampling locations, a biological/ecological clearance, and a utility clearance, the latter conducted by NWS Concord personnel and representatives of the concerned utilities. The procedures for the biological/ecological clearance are discussed in the FSP (PRC/Montgomery Watson 1995b). A UXO assessment, consisting of a visual inspection by a UXO subcontractor, was conducted at the site in order to identify potential explosive hazards during the investigation. The UXO assessment identified five 40-mm grenades imbedded in the surface at the top of the target berm; however, the grenades were not located in the area of the berm sampling. The area where the grenades were found was cordoned off and the target berm was sampled without disturbing the grenades.

#### **8.4.2 Surface Soil Sampling**

Seven surface soil samples were collected at the locations PFRSB026 through PFRSB032 in the site drainage channel (Figure 8-4). Sample PFRSB029 was located in the channel at the target berm, with PFRSB028 and PFRSB027 located progressively downstream within the firing area. Samples PFRSB026 and PFRSB030 through PFRSB032 were located in the channel outside of the firing area, with sample PFRSB032 located in an incised gully downslope of the graded area of the firing range. The total length of the drainage channel that was sampled was approximately 500 feet. The drainage channel surface soil samples were analyzed for metals and pH. Samples PFRSB027 through PFRSB029 were also analyzed for TOC.

### **8.4.3 Geoprobe Borings**

Surface and subsurface soil samples were collected from target berm Geoprobe borings PFRSB020 and PFRSB021 (Figure 8-4). The surface samples were collected at the surface of the target berm at the height of the firing targets. The highest concentrations of metals from projectiles were likely to be found in this area. Subsurface samples were collected from borings PFRSB020 and PFRSB021 at three intervals between the surface and bedrock. Bedrock was encountered in borings PFRSB020 and PFRSB021 at depths of 6.0 and 7.5 feet, respectively. All target berm samples were analyzed for metals and pH. Two samples collected at boring PFRSB021 were analyzed for SVOCs.

Eight Geoprobe soil samples were collected from ambient borings. As discussed in Appendix A, the metal concentrations from these samples were used to determine ambient metal concentrations. The samples were collected at the surface and 10 feet bgs from four borings, PFRSB022 through PFRSB025, located on the south protective berm. The samples were analyzed for metals and pH.

### **8.4.4 Summary of Quality Assurance/Quality Control Field Procedures**

Field QA/QC sampling conducted during the field effort at the Pistol Firing Range consisted of the collection of field duplicates, referee duplicates, field blanks, equipment rinsates, and trip blanks in accordance with the FSP (PRC/Montgomery Watson 1995b). The results of these QA/QC samples are discussed in the QCSR (Appendix I). Field equipment was decontaminated in accordance with the procedures outlined in the FSP. Field instruments used during the field effort were calibrated and maintained in accordance with the QAPjP (PRC/Montgomery Watson 1995c). Borings and samples were documented in accordance with the WP and the FSP (PRC and Montgomery Watson 1995a,b).

### **8.4.5 Deviations from Proposed Investigation Approach**

Two subsurface soil samples collected from target berm location PFRSB021 were analyzed for SVOCs because an organic odor was noticed during sample collection. Two additional ambient borings, PFRSB024 and PFRSB025, were added to the two ambient borings specified in the work plan to increase the size of the data set used to calculate ambient soil concentrations. The collection depth of the ambient boring samples was increased from 7.0 ft bgs as proposed to 10.0 feet bgs to ensure soil samples were



collected beneath the root zone, the presence of which can alter the distribution of metals. Samples collected at depth in the ambient borings were not analyzed for TOC as specified in the FSP.

## **8.5 CHEMICAL CHARACTERIZATION**

This section presents the results of chemical analyses for soil samples collected at the Pistol Firing Range. Soils sampled during the RI at the Pistol Firing Range were submitted for the laboratory analyses described in Section 8.4 above and as presented in Table 8-2. The analytical results of sampling are presented in Appendix J.

### **8.5.1 Results of Soil Sample Analyses**

This section presents the significant results of the soil sampling effort at Site 24A. Samples were collected from Geoprobe borings and the ground surface at the locations described in Section 8.4. The results of sampling are compared to the PRGs established for residential soils (EPA 1995; Appendix L). The soil results are also compared to TTLC values defined in Title 22 of the California Code of Regulations. TTLC values are used to categorize waste. If concentrations exceed the TTLC values, then the waste is defined to exhibit the characteristic of toxicity. In this RI, the TTLC values are not used to characterize waste, but instead are used to compare to soil concentrations to locate any hot spots (areas of unusually high concentrations). The chemicals with concentrations exceeding these criteria are the only chemicals discussed in the following sections, and these chemicals are carried into the HHRA. Organic and inorganic constituents detected in Site 24A soils at concentrations exceeding PRG values and arsenic detections exceeding site ambient levels are shown on Figure 8-5.

#### **8.5.1.1 Organic Compounds in Soils**

Soil samples collected at boring PFRSBO21 (0.5 to 1.5 feet and 7.2 to 7.5 feet) were submitted to the laboratory for SVOC analysis because of an organic odor that was noticed during surface sample collection. Nineteen SVOCs were detected in the near-surface sample, at concentrations up to 160 mg/kg (phenanthrene) (Table 8-3). None of the SVOCs were detected at concentrations exceeding their TTLC values. Eight of the SVOCs, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene, were detected at concentrations exceeding PRG values. The same 19 SVOCs were detected in the sample collected at depth; however, the concentrations for all but one SVOC (phenol) were at least

one order of magnitude less than those for the surface sample. The concentrations of five of the SVOCs in the sample collected at depth, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and dibenzo(a,h)anthracene, remained greater than the PRG values (Table 8-3). It has been observed that creosote-preserved timbers are used at the site for low retaining walls for the berms and for target supports, and are likely the source of the SVOCs.

#### **8.5.1.2 Inorganic Compounds in Soils**

Twenty-three soil samples collected at the Pistol Firing Range during the RI were submitted for CLP metals analysis. The ambient metal concentrations for Site 24A were calculated from metal concentrations detected in ambient soil samples (Appendix A).

Metals detected in soils collected at the site at concentrations exceeding PRG values were arsenic, antimony, beryllium, and lead (Table 8-4). Lead was detected in four soil samples at concentrations exceeding the TTLC value of 1,000 mg/kg. Arsenic was detected in the majority of the samples collected at the Pistol Firing Range at concentrations exceeding the PRG value; however, site ambient concentrations of arsenic greatly exceed the PRG value (7.3 mg/kg compared to 0.38 mg/kg), indicating that elevated arsenic concentrations are probably indigenous to the site. Site ambient concentrations of beryllium also exceed the PRG value (0.56 mg/kg compared to 0.14 mg/kg), with only one sample (PFRSB021, 4.5 to 5.5 feet bgs) exceeding the site ambient value. For antimony and lead, detections greater than the PRG are also greater than ambient values. The distributions of antimony, arsenic, beryllium, and lead in site soil samples are discussed below.

#### **Antimony**

Antimony was detected at a concentration of 33.9 mg/kg in target berm sample PFRSB021 (0.5 to 1.5 feet bgs), which exceeds the PRG value of 31 mg/kg. Antimony was also detected at concentrations exceeding the site ambient value of 1.2 mg/kg in surface samples collected from target berm points PFRSB020 and PFRSB021, at a depth of 4.5 to 5.5 feet bgs in PFRSB021, and the four most upgradient drainage channel locations, PFRSB026 through PFRSB029. Antimony was not detected in the two most downgradient channel samples, PFRSB031 and PFRSB032. The diminishing concentrations with distance from the target berm indicate that the antimony concentrations present are likely to be the result of site activities. Antimony is used as an alloy for bullets (Merck & Co., Inc. 1983).

## **Arsenic**

Arsenic was detected at concentrations exceeding the site ambient value of 7.3 mg/kg in samples collected from the target berm (PFRSB021, 0.0 to 0.5 feet bgs and 0.5 to 1.5 feet bgs) and the drainage channel surface sample closest to the target berm (PFRSB029).

## **Beryllium**

Beryllium was detected at concentrations exceeding the ambient value of 0.56 mg/kg in one sample collected from the target berm, PFRSB021 (0.67 mg/kg at 4.5 to 5.5 feet bgs). With the exception of one ambient sample PFRSB023 (10.0 to 10.5 feet bgs), all other samples with detected beryllium were collected from the target berm.

## **Lead**

Fragments of lead projectiles were found in the target berm while collecting the surface and near-surface samples. Lead concentrations exceeding the PRG value of 130 mg/kg were detected in the surface and near-surface samples collected from the target berm at concentrations up to 6,030 mg/kg (PFRSB021, 0.5 to 1.5 feet bgs). Lead concentrations exceeding the TTLC value of 1,000 mg/kg were detected in three surface samples and one near-surface sample collected from the target berm at concentrations ranging from 1,230 to 6,030 mg/kg. Lead concentrations diminish with depth beneath the surface or near-surface of the target berm. The three most upstream drainage channel surface samples, PFRSB027 through PFRSB029, also contained lead at concentrations exceeding PRGs, with concentrations up to 1,230 mg/kg (PFRSB029). Lead concentrations in the channel diminish with distance from the target berm, with the most downgradient sample (PFRSB032) containing lead at a concentration of 11.0 mg/kg, below the site ambient value of 18 mg/kg. The surface samples collected at drainage ditch locations PFRSB026, PFRSB030, and PFRSB031 contained lead at concentrations exceeding the site ambient value but below the PRG value.

### **8.5.2 Summary of Chemical Characterization**

As stated in Section 8.4, the site was divided into three study areas to assess the spatial extent of chemicals at the site. This section summarizes the organic and inorganic chemicals detected within the two study areas associated with site activities and drainage. The third area contained the locations of the ambient soil samples, and those results were used to calculate ambient metal concentrations. Analytical results relating to the site as a whole are discussed prior to the summary of the analytical results from the study areas.

Concentrations of metals at the site were generally highest in the soil samples collected from the target berm and the upgradient end of the site drainage channel. Antimony and lead were detected at concentrations exceeding PRGs, and are likely present as a result of past and present site activities, as evidenced by their distribution at the site and use in ballistics. Arsenic and beryllium are likely indigenous to the site at concentrations exceeding PRGs.

#### **Target Berm**

Several SVOC compounds were detected in the surface berm samples at concentrations exceeding PRGs. The SVOC concentrations diminished strongly with depth below surface; however, several SVOCs in the berm sample collected at depth exceeded PRG values. The presence of SVOCs in target berm soils is likely the result of the use of creosote-treated timbers in the sampling area.

Concentrations of metals in target berm samples collected at the soil/bedrock interface were substantially lower than those collected near the surface, with only barium and beryllium exceeding ambient values in PFRSB021 (7.2 to 7.5 feet bgs).

#### **Site Drainage Channel**

Metals concentrations in the drainage channel generally diminish significantly with distance from the target berm. The soils in the two most downgradient sampling locations in the drainage channel do not appear to be affected by sediment carried from the range area; rather, because these samples were collected from an incised area of the channel that appears to be controlled by erosion rather than

deposition, these sample concentrations reflect indigenous soils conditions rather than anthropogenic conditions.

## **8.6 REVISED CONCEPTUAL SITE MODEL**

The conceptual site model was developed after the SI and is presented in the WP (PRC/Montgomery Watson 1995a). This conceptual site model has been updated to include the RI data. The model lists potential sources and COPCs identified in Section 8.5, and highlights the most likely migration routes (Figure 8-6). The model is used in conjunction with the results from the human health and ecological risk assessments and the fate and transport properties of the COPCs to assess site conditions and the need for remediation. The Pistol Firing Range is located in a cut-out area of a west-facing hillside; the area behind the target is a steep slope cut into the hillside. Although it was reported that artificial fill was placed over an old berm where the slugs strike, the contact between the fill and old berm was not observed during the SI or RI. Because the range is still being used, with no plans for closure, the issue of concern was whether metals in soil are eroding from the hillside and being carried in a visible drainage course off site to the west. The SI and RI data indicate the metals that are not leaching from site soils. The principal chemical migration pathway is surface soil erosion, since metals are being transported off site via the drainage ditch. Metals are not found at depth, so leaching of metals does not appear to be occurring. Polynuclear aromatic hydrocarbons (PAH) were detected on site and are believed to be a localized occurrence resulting from soil contact with creosote-preserved timbers used to build retaining walls on site.

TABLE 8-1

**REMEDIAL INVESTIGATION  
SUMMARY OF GEOTECHNICAL TESTING RESULTS  
SITE 24A - PISTOL FIRING RANGE  
WPNSTA CONCORD**

Laboratory Identification	Soil Sample Location	Sample Interval (feet bgs)	Grain Size	USCS Symbol	Permeability (cm/sec)	Porosity (%)	Density lb/ft <sup>3</sup>	Specific Gravity	Moisture (%)
FR102	PFRSB027	0.0-0.5	Clayey sand with organics	SC	3.00E-07	45.67	91.2	2.69	29.7
FR103	PFRSB028	0.0-0.5	Sandy clay with organics	SC	4.00E-07	45.75	92.4	2.73	29.3
FR104	PFRSB029	0.0-0.5	Silty sand	SM	6.00E-04	37.87	104.7	2.70	19.2

TABLE 8-2

**SUMMARY OF SOIL ANALYSES, SITE 24A  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

Sample Location	Matrix	Sample Depth	Organic Compounds	Inorganic Constituents		Other Parameters					
			CLP SVOC	Hex. Chromium	CLP Metals	WET-DI	Geophys. Param.	Grain Size	pH	TOC	
PFRSB020	Soil	0 - .75		1	1	1				1	
	Soil	.75 - 1.75			1					1	
	Soil	4 - 5			1					1	
	Soil	5 - 6			1					1	
PFRSB021	Soil	0 - .5			1	1				1	
	Soil	.5 - 1.5	1		1					1	
	Soil	4.5 - 5.5			1					1	
	Soil	7.2 - 7.5	1		1					1	
	Soil	0 - .5			1	1				1	
PFRSB026	Soil	0 - .5			1	1		1	1	1	1
PFRSB027	Soil	0 - .5			1	1		1	1	1	1
PFRSB028	Soil	0 - .5			1	1		1	1	1	1
PFRSB029	Soil	0 - .5		1	1	1		1	1	1	1
PFRSB030	Soil	0 - .5			1	1				1	
PFRSB031	Soil	0 - .5			1	1				1	
PFRSB032	Soil	0 - .5			1	1				1	
Total:			2	2	15	9	3	3	15	3	3

Note:

Section 3.0 tables list the analytical methods used and Appendix I, Quality Control Summary Report, describes quality assurance samples.

TABLE 8-3

SUMMARY OF DETECTED SVOCs IN SOIL  
SITE 24A - PISTOL FIRING RANGE  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD

Sample Location	Investigation	Sample Depth (ft bgs)	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Chrysene	Fluoranthene	Phenanthrene	Phenol	Pyrene	2-Methylnaphthalene	Acenaphthene	Anthracene	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Carbazole	Dibenz(a,h)anthracene	Dibenzofuran	Fluorene	Indeno(1,2,3-cd)pyrene	Naphthalene	High Molecular Weight PAHs	Low Molecular Weight PAHs	Total PAHs
Residential PRGs	(mg/kg)		0.61	0.061	0.61	6.1	2,600	NE	39,000	100	NE	110	5.7	NE	0.61	22	0.061	140	90	0.61	240	NE	NE	NE
			Concentration (mg/kg)																					
PFRSB021	RI	.5 - 1.5	25	9.9	13	26	110	160	4.1	78	7.9	36	45	2.3	15	20	2.2	25	39	4.1	2.9	283.2	276.8	560
	RI	7.2 - 7.5	0.96	0.43	0.66	1.1	3.8	5.5	1.7	2.7	0.27	0.95	1.4	0.22	0.66	0.62	0.11	0.88	1.3	0.21	0.19	10.63	9.27	19.9

NE - Not Established

Concentrations shown in **bold** exceed the residential PRG.

Appendix J contains full analytical tables which include the date sampled, samples with nondetected concentrations, and detection limits.



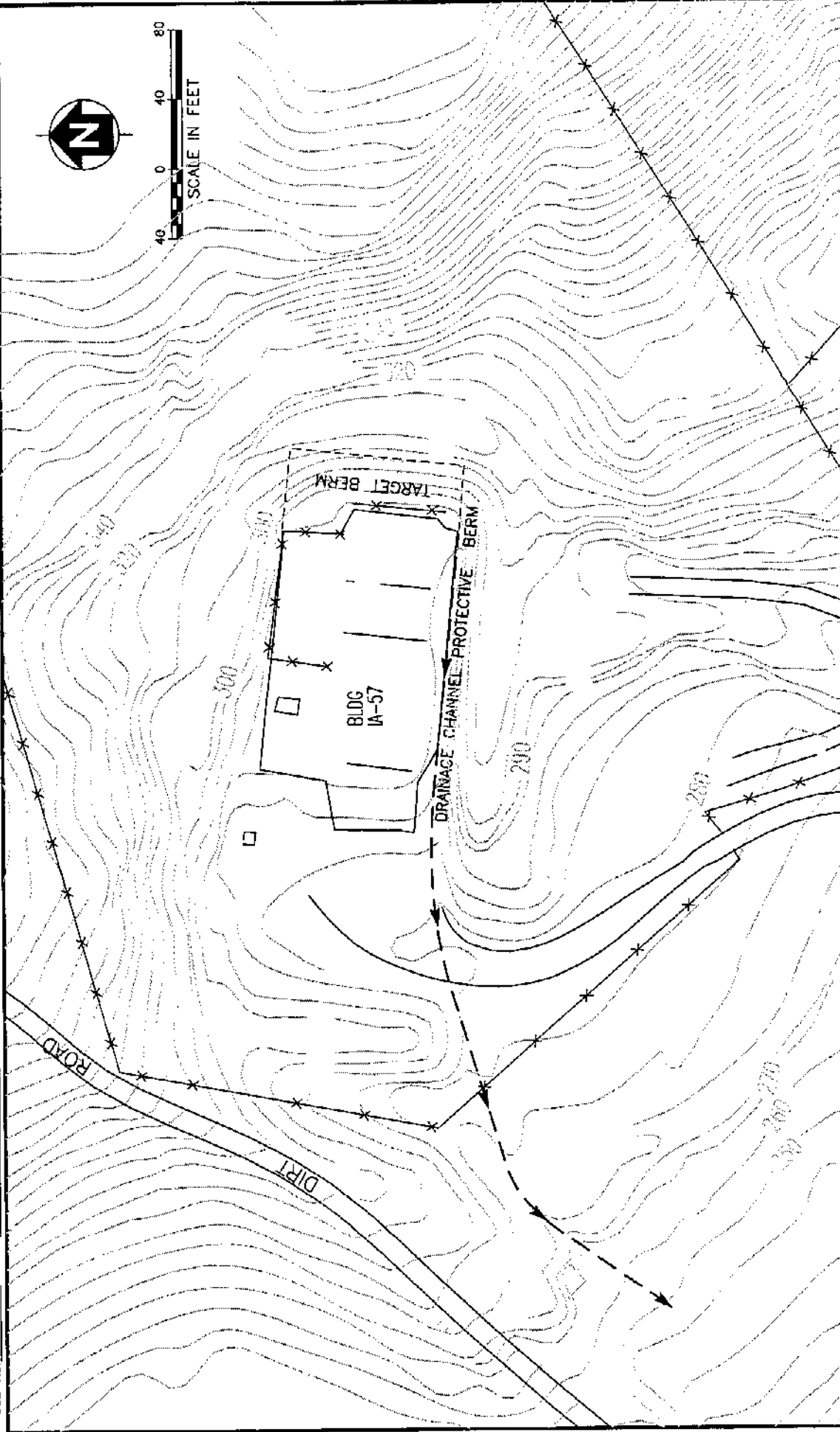
TABLE 8-4

**SUMMARY OF DETECTED METALS IN SOIL  
SITE 24A - PISTOL FIRING RANGE  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

Sample Location	Investigation	Sample Depth (ft bgs)	Aluminum	Antimony	Arsenic	Barium	Beryllium	Chromium	Cobalt	Copper	Lead	Manganese	Mercury	Molybdenum	Nickel	Vanadium	Zinc
Residential PRCs (mg/kg)			77,000.00	31.00	0.38	5,300.00	0.14	77,000.00	4,600.00	2,800.00	130.00	3,200.00	23.00	380.00	150.00	540.00	23,000.00
Concentrations of Total Metals (mg/kg)																	
PFRSB020	RI	0 - .75	10,400.00	27.00	6.10	99.80	0.21	18.90	9.50	102.00	2,470.00	208.00	--	--	14.60	33.10	82.30
	RI	4 - 5	6,440.00	--	2.80	115.00	--	17.00	7.60	10.30	4.70	155.00	--	2.20	109.00	21.60	42.00
	RI	5 - 6	7,740.00	--	--	147.00	--	16.00	7.60	9.20	3.60	163.00	--	--	9.70	24.40	40.70
	RI	.75 - 1.75	5,730.00	--	--	112.00	--	11.90	6.70	7.40	3.90	203.00	--	--	7.70	26.00	40.80
PFRSB021	RI	0 - .5	12,600.00	22.30	7.60	139.00	0.25	29.30	10.90	418.00	3,430.00	263.00	--	1.90	25.60	47.80	--
	RI	.5 - 1.5	10,300.00	33.90	8.60	135.00	0.39	26.80	8.90	461.00	6,030.00	286.00	--	--	22.10	37.00	--
	RI	4.5 - 5.5	14,100.00	1.40	5.40	162.00	0.67	24.10	16.30	23.70	43.90	485.00	--	--	25.50	57.80	--
	RI	7.2 - 7.5	12,200.00	0.60	4.20	238.00	0.50	24.80	11.30	19.30	20.50	215.00	--	--	21.40	45.60	--
PFRSB026	RI	0 - .5	19,100.00	1.80	4.60	83.40	--	--	18.50	132.00	125.00	386.00	0.14	--	22.00	60.00	311.00
PFRSB027	RI	0 - .5	13,000.00	6.40	6.10	132.00	--	76.00	15.40	57.80	317.00	538.00	--	--	55.30	61.90	130.00
PFRSB028	RI	0 - .5	12,600.00	3.70	6.20	172.00	--	--	17.80	54.30	313.00	602.00	0.06	--	53.50	60.60	120.00
PFRSB029	RI	0 - .5	7,560.00	6.60	7.80	50.00	--	--	9.40	74.60	1,230.00	236.00	--	--	31.80	30.60	66.80
PFRSB030	RI	0 - .5	14,100.00	0.65	4.30	87.70	--	--	13.20	62.60	61.70	270.00	0.11	--	15.50	47.20	338.00
PFRSB031	RI	0 - .5	10,500.00	--	5.70	103.00	--	--	10.50	27.40	22.20	424.00	--	--	15.30	31.20	137.00
PFRSB032	RI	0 - .5	14,500.00	--	5.60	123.00	--	--	9.70	20.40	11.00	440.00	--	--	14.60	41.30	94.40

Concentrations shown in **bold** exceed the residential PRG

Concentrations of calcium, iron, magnesium, potassium, and sodium are not shown because they are common soil minerals, do not have PRCs, and are not expected to be the result of site activities. Appendix J includes a complete listing of the metals results.



LEGEND:

— X — FENCE

— — — DRAINAGE CHANNEL (WITH ARROW INDICATING FLOW DIRECTION)

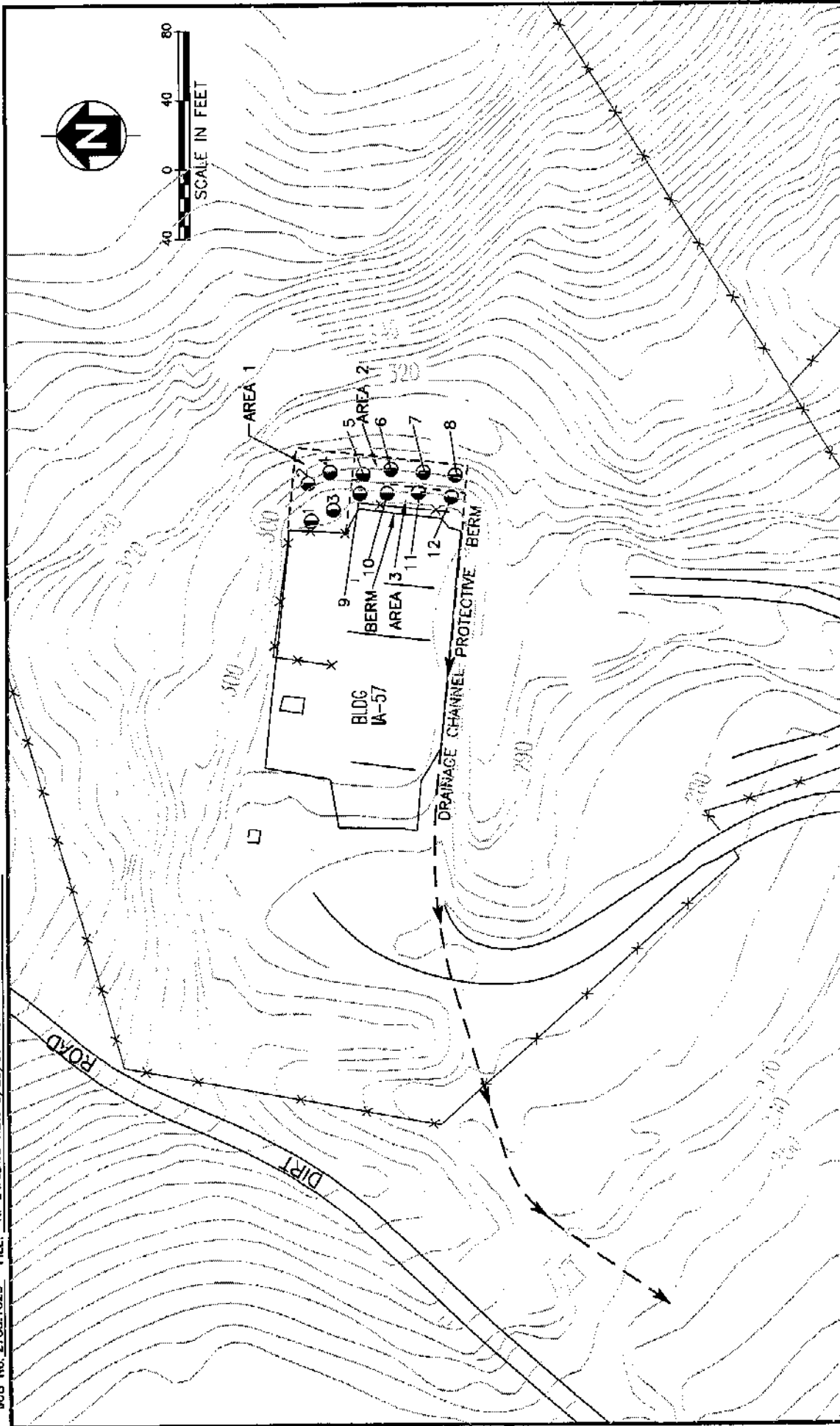
— — — GROUND SURFACE CONTOURS (FT MSL)

NWS CONCORD - INLAND AREA  
CONCORD, CALIFORNIA

FIGURE 8-1

SITE 24A - PISTOL FIRING RANGE  
SITE FEATURES

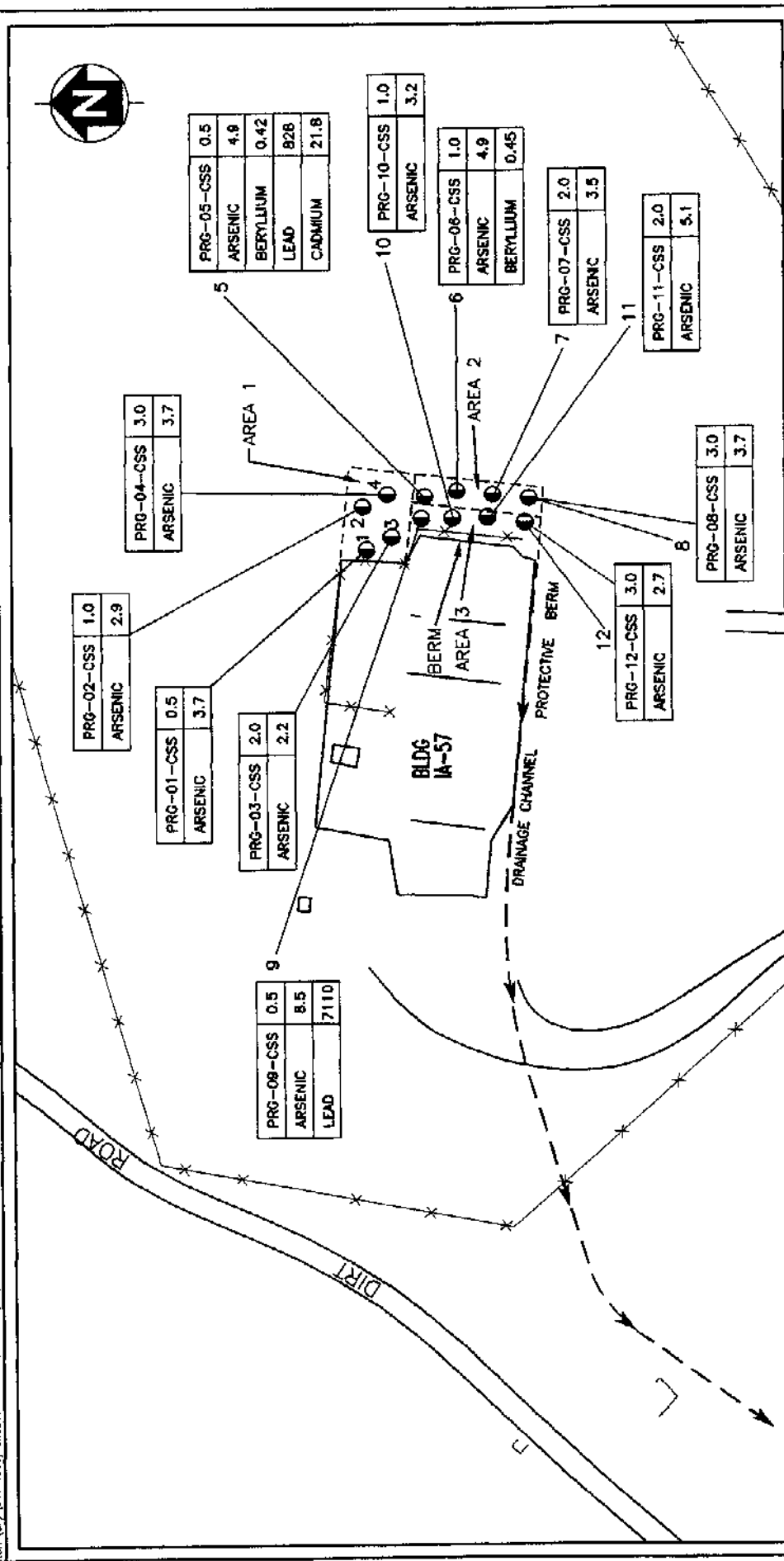
SIZE	DATE	DWG NAME	REV



NWS CONCORD - INLAND AREA CONCORD, CALIFORNIA	
<b>FIGURE 8-2</b> <b>SITE 24A - SITE INVESTIGATION</b> <b>SAMPLING LOCATIONS</b>	
SIZE	DATE
DWG NAME	REV

**LEGEND:**

- X — FENCE
- DRAINAGE CHANNEL (WITH ARROW INDICATING FLOW DIRECTION)
- GROUND SURFACE CONTOURS (FT MSL)
- XX● SOIL BORING LOCATION PRG-XX-SB (SAMPLES COLLECTED AT 0, 1, 2 AND 3 FT BGS)

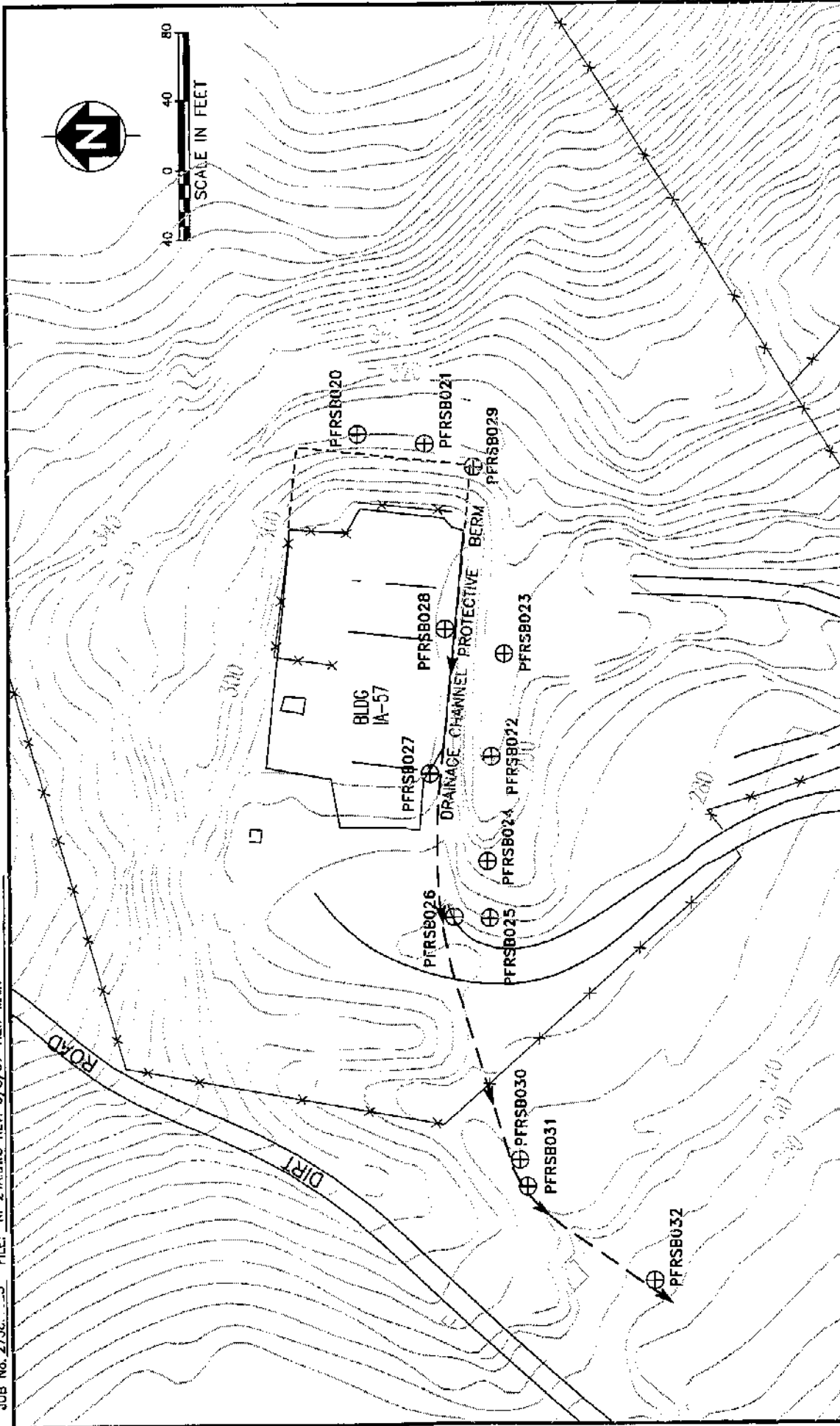


40' 0' 40' 80'  
SCALE: 1"=80'

NAVAL WEAPONS STATION CONCORD  
CONCORD, CALIFORNIA

FIGURE 8-3  
INORGANIC CONSTITUENTS DETECTED  
DURING THE SITE AT SITE 24A IN SOIL

SIZE	DATE	DWG NO.	REV
A		SITE24INORGANICS	2



LEGEND:

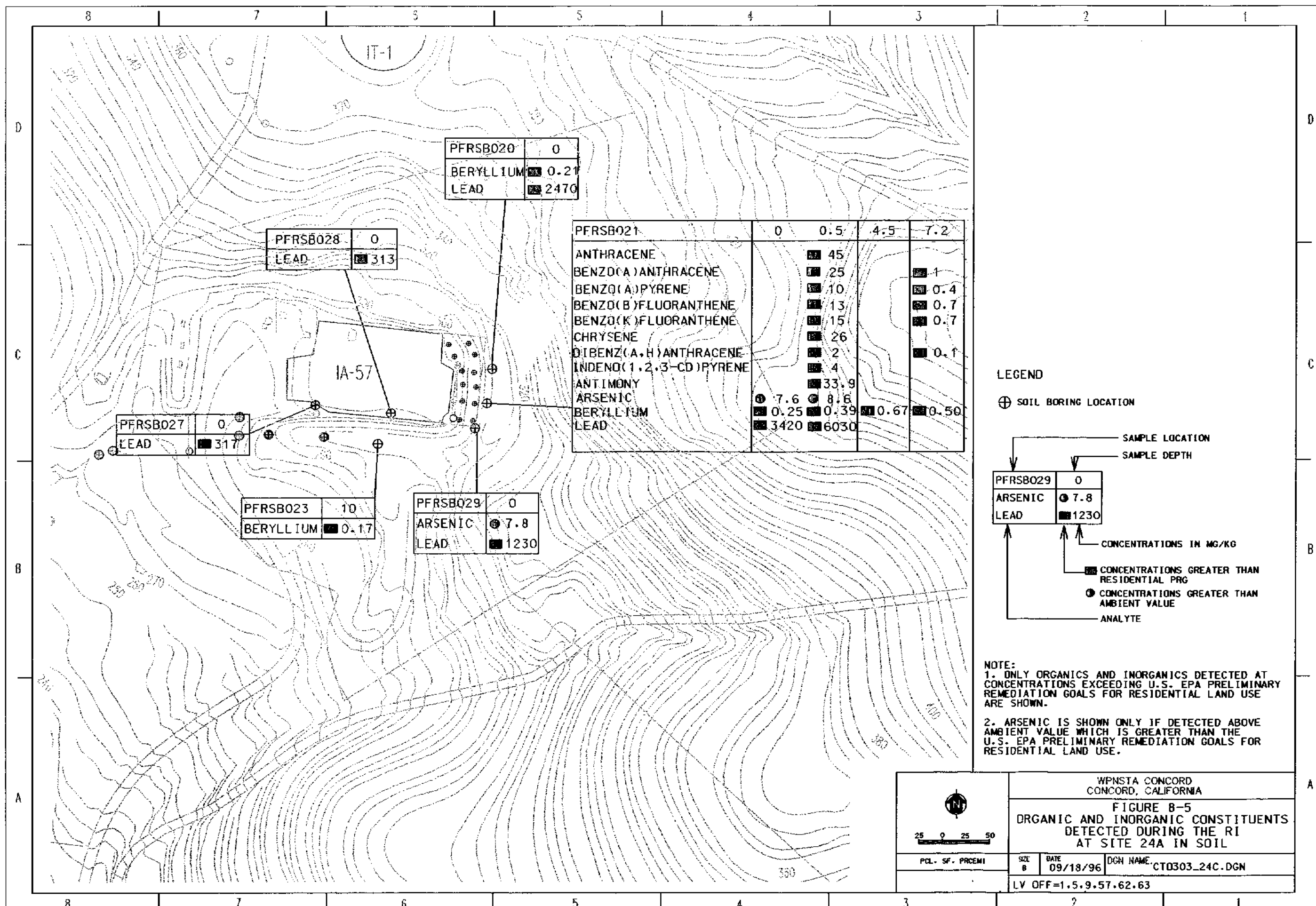
- X — FENCE
- — — DRAINAGE CHANNEL (WITH ARROW INDICATING FLOW DIRECTION)
- GROUND SURFACE CONTOURS (FT MSL)
- ⊕ SOIL BORING LOCATION

NWS CONCORD - INLAND AREA  
CONCORD, CALIFORNIA

FIGURE 8-4

SITE 24A - REMEDIAL INVESTIGATION  
SAMPLING LOCATIONS

SIZE	DATE	DWG NAME	REV



## **9.0 RESULTS OF THE RI/FS AT BUILDING IA-20 (SITE 27)**

This section presents the results of the RI at Building IA-20 (Site 27). Building IA-20 houses a chemical laboratory and a materials testing laboratory. Soil was sampled around Building IA-20 to study the impact of reported disposal of waste generated at this building and the use of a UST.

### **9.1 PHYSICAL DESCRIPTION AND PAST OPERATIONS**

Site 27 consists of the area north and to the sides of Building IA-20, which is located on the eastern side of H Street about 800 feet southeast of the State Highway 4 underpass (Figure 1-3). Adjacent to Building IA-20 is Building IA-36, a boiler house (Figure 9-1). Building IA-20 houses the chemical laboratory and a materials testing laboratory of the WQEC Scientific and Engineering Division. The chemical laboratory is primarily used to test oils and hydraulic fluids and to develop new weapons test methods. The materials testing laboratory evaluates the structural integrity and dynamics of ordnance casings, shells, and missiles.

The IAS reported that the amount of laboratory waste generated was less than 100 pounds per year (no year cited) and consisted mostly of test fluids and steel, brass, and aluminum scraps and shavings. The IAS (E&E 1983) reported the following list of annual waste generated by the laboratory (no year cited):

Chlorofluorocarbon (CFC)-113	100 gallons
Denatured alcohol	50 gallons
Mineral spirits	50 gallons
Oil	50 gallons

Additional small quantities of acids and bases were also generated at the laboratory. These latter wastes were neutralized and introduced into the sewer with permission from Contra Costa County Utilities District. Since 1983, the laboratory has collected and disposed of its waste off site (E&E 1983).

Along the southwest side of Building IA-36 is a 10,000-gallon diesel UST and vadose zone well. The tank reportedly passed a 1989 tank pressure test (ERM-West 1989). However, during field activities in July 1992, PRC personnel observed that soil had been removed from the top of the tank and the word "leaking" was written on the tank. The soil near the tank was visibly stained and emitted a strong hydrocarbon-like odor.

## **9.2 PHYSICAL CHARACTERISTICS**

The following section presents the physical setting and geology for Site 27.

### **9.2.1 Physical Setting**

Site 27 is located on the east side of H Street, approximately 800 feet south of the State Highway 4 causeway (Figure 1-3). Buildings IA-20 and IA-36 (Figure 9-1) are located at the north end of a cluster of buildings and sit on a slight rise above a driveway/parking area that serves the cluster of buildings. North of Buildings IA-20 and IA-36 is the subject drainage swale, which drains to the west, away from the Contra Costa Canal and into the flat lands west of H Street. Above the drainage swale is a steep grass- and brush-covered hill that slopes to the southwest. Approximately 150 feet from the site is the Contra Costa Canal. Farther upslope is the State Highway 4 causeway.

### **9.2.2 Geology**

Limited geologic information is available from the SI for Site 27. Information is based on one boring completed at the site to a depth of 15 feet bgs during an investigation of the integrity of an existing UST and a series of shallow soil borings (less than 4.5 feet). Based on the information available, the sediments beneath Site 27 appear to consist of primarily clay, silty clay, and sandy clay with a few interbedded sand stringers. Boring logs for Site 27 are presented in Appendix B. The vertical permeability of soils collected from the swale bottom at a depth of 3.0 to 4.0 feet bgs was assessed using geotechnical samples collected during the RI. Calculated permeabilities range from 6.00E-08 cm/sec (MTLSB024) to 2.00E-05 cm/sec (MTLSB023). The geotechnical laboratory reports are presented as Appendix D; a summary of geotechnical parameters for soils from Site 27 is presented in Table 9-1.

## **9.3 RESULTS OF PREVIOUS INVESTIGATIONS**

**Initial Assessment Study.** The IAS did not designate Building IA-20 as a specific site, but activities and past disposal practices at the building were reported in another part of the IAS report (Section 6.0 - Activity Findings). The IAS originally reported that Site 18, a reported burn pit and solvent disposal area behind Building IA-25, showed no visible evidence of contamination. Two investigations were conducted at Building IA-25, one by the Navy in November 1988 and the second by IT Corp. in



January 1990. The analytical results for these investigations showed no evidence of disposal activity behind Building IA-25, as described in the IAS (IT Corp. 1989). Because no contamination was detected behind Building IA-25 and because the IAS reported that between 1964 and 1968 chlorofluorocarbon (CFC)-113 was routinely disposed of onto the soil behind Building IA-20 at a rate of 1 gallon per week, IT Corp. believed that the IAS incorrectly reported Building IA-20 activities as occurring at Building IA-25. Therefore, IT Corp. concluded that the Site 18 activities reported in the IAS occurred at Building IA-20. Subsequently, the Building IA-20 area was designated Site 27 (IT Corp. 1989).

Site studies reported three past activities that may be of concern at Site 27 (Building IA-20): (1) the IAS reported CFC-113 disposal behind Building IA-20, although this contaminated soil was reportedly excavated and removed (E&E 1983); (2) IT Corp. speculated that solvent disposal possibly occurred in the area behind Building IA-20; and (3) IT Corp. also speculated that a burn pit was possibly located behind Building IA-20.

**Site Investigation.** Twenty locations were sampled, including six locations in a swale located behind Building 1A-20, in nine locations near the building, and five locations in the former drum storage areas (Figure 9-2). Soil samples were collected at 0 to 0.5 feet bgs in the ditch, and at 0 to 0.5 feet bgs and 2.5 to 3.0 feet bgs in all other locations. Thirty-nine samples were collected from the 20 locations and composited in the laboratory to yield 12 depth-specific samples and two duplicate samples (Figure 9-2).

The soil at the site is identified as a silty-clay to at least 3 feet bgs with some sandy fill in surface samples collected along the sides of the buildings. There was no visible evidence of soil removal from behind Building IA-20 to indicate that possible CFC-113 contaminated soil was removed from the area, as reported in the IAS. To investigate the reported disposal activities at Site 27, soil samples were analyzed for CFC-113, VOCs, TPH, PCB/pesticides, pH, and sulfate. The soil samples were field-screened for TPH and PCBs. The analytical laboratory results were used to verify the field screening results.

No CFC-113 was detected in the soil samples. The maximum detected concentrations of VOCs were 2-butanone at 3  $\mu\text{g}/\text{kg}$ , acetone at 0.110  $\text{mg}/\text{kg}$ , carbon disulfide at 6  $\mu\text{g}/\text{kg}$ , methylene chloride at 0.026  $\text{mg}/\text{kg}$ , and toluene at 0.013  $\text{mg}/\text{kg}$ . All the maximum detected VOC concentrations were found in the swale samples with the exception of toluene, which was detected in sample MTL-09-CSS, collected between Buildings IA-20 and IA-36 (Figure 9-2). The maximum concentrations of TPH-G

and TPH-D were 0.349 and 11.9 mg/kg, respectively. All of the TPH concentrations were found in the swale, with the exception of TPH-D in sample MTL-10-CSS, collected between Buildings IA-20 and IA-36 (Figure 9-3). No chlorinated solvents such as tetrachloroethene (PCE) were detected in any of the soil samples. No PCBs were detected in the soil samples. The maximum detected concentrations of pesticides were p,p-DDD at 0.311 mg/kg, p,p-DDE at 0.103 mg/kg, 4,4'-DDT at 0.442 mg/kg, dieldrin at 0.0734 mg/kg, heptachlor epoxide at 0.00952 mg/kg, alpha-chlordane at 0.723 mg/kg, and gamma-chlordane at 0.821 mg/kg (Figure 9-3). The pH in the soil samples ranged from 7.7 to 9.36 and sulfate concentrations ranged from 4.54 to 43.10 mg/kg.

**UST Investigation and Removal.** In September 1993, HLA conducted an investigation of the soil around the 10,000-gallon diesel fuel UST located along the southwest side of Building IA-36. One boring was drilled along the southwest side of the UST. Samples were collected at depths of 7.5, 11, and 16 feet bgs and were analyzed for TPH-D, TPH-G, and pesticides. TPH-D was detected at 620 mg/kg in the sample collected at 11 feet bgs (HLA 1995).

On April 15, 1997, K.T.W. & Associates, Inc. (KTW) excavated and removed the UST. On April 28, 1997, KTW excavated hydrocarbon contaminated soil from around the former UST and to a depth of 25 feet below the existing grade. A soil sample was collected from the excavation to evaluate the concentration of hydrocarbons remaining in the ground when the UST excavation was backfilled on April 28, 1997. The sample did not contain detectable hydrocarbon contamination. KTW concluded that diesel-impacted soil was substantially removed and only residual diesel-impacted soil remains in the ground adjacent to Building IA36 (KTW 1997).

#### **9.4 REMEDIAL INVESTIGATION FIELD ACTIVITIES**

Soil sampling at the site was conducted to assess the nature and extent of organochlorine (OC) pesticides detected during the SI in samples from the drainage swale to the north of Buildings IA-20 and IA-36 and in the roadside drainage channel into which the swale drains (Figure 9-4). Soil was sampled in the drainage channel to assess whether contaminants in the swale are being transported off site. The sampling effort also assessed the extent of petroleum hydrocarbons that may be present in the soils from use of a UST located next to Building IA-36. For the purpose of addressing the spatial extent of contaminants at the site, the site has been divided into four areas. These areas are (1) the drainage swale where the majority of wastes were reportedly dumped (the swale consists of two

subareas, the swale bottom and the swale bank), (2) the drainage channel along H Street, which receives water draining from the swale, (3) the areas around Buildings IA-20 and IA-36, where some wastes may have been dumped and where a diesel fuel UST is located, and (4) the slope north of the drainage slope, where soil sample results were used to assess ambient pesticide concentrations at the site.

#### **9.4.1 Site Reconnaissance Activities**

Site reconnaissance activities consisted of a visual inspection of sampling locations, a biological/ecological clearance, and a utility clearance, the latter conducted by NWS Concord personnel and representatives of the concerned utilities. The procedures of the biological/ecological clearance are discussed in the FSP (PRC/Montgomery Watson 1995b).

#### **9.4.2 Surface Soil Sampling**

Surface soil samples MTL SB012, MTL SB013, and MTL SB015 were collected along the drainage swale bank behind Building IA-20; surface soil samples MTL SB014, and MTL SB017 through MTL SB019 were collected around the perimeter of Buildings IA-20 and IA-36 to assess the levels of organic compounds in the soil that may have resulted from waste disposal or UST operation. All drainage swale and building perimeter samples were analyzed for SVOCs, OC pesticides/PCBs, and TPH-E.

Surface soil samples MTL SB010 and MTL SB016 were collected at two locations in the drainage channel adjacent to H Street to assess whether chemicals are being transported off site by surface runoff. Samples MTL SB010 and MTL SB016 were located approximately 50 and 10 feet downstream, respectively, from where the swale intersects the roadside drainage channel (Figure 9-4). The samples were analyzed for SVOCs, OC pesticides/PCBs, and TPH-E.

Surface soil samples MTL SB011 and MTL SB020 through MTL SB022 were collected on the hillside north of the drainage swale. Samples collected from this area served to establish ambient concentrations of OC pesticides. The samples were analyzed for SVOCs, OC pesticides/PCBs, and TPH-E.

#### **9.4.3 Geoprobe Borings**

Surface and subsurface soils were collected from Geoprobe borings MTL SB023 through MTL SB025, located at the bottom of the drainage swale, to assess the levels of organic compounds in the soil that may have resulted from waste disposal and UST operations. Samples were collected at the surface and at 3.0 feet bgs and were analyzed for VOCs, SVOCs, OC pesticides/PCBs, TPH-E. In addition, the subsurface samples were analyzed for TOC and geotechnical parameters.

#### **9.4.4 Summary of Quality Assurance/Quality Control Field Procedures**

Field QA/QC sampling conducted during the field effort at Site 27 consisted of the collection of field duplicates, referee duplicates, field blanks, equipment rinsates, and trip blanks in accordance with the FSP (PRC/Montgomery Watson, 1995b). The results of these QA/QC samples are discussed in the QCSR (Appendix I). Field equipment was decontaminated in accordance with the procedures outlined in the FSP. Field instruments used during the field effort were calibrated and maintained in accordance with the QAPjP (PRC/Montgomery Watson 1995c). Borings and samples were documented in accordance with the WP and the FSP.

#### **9.4.5 Deviations from Proposed Investigation Approach**

Drainage channel sample MTL SB010 was moved from a point approximately 130 feet downstream from the intersection of the drainage swale and the drainage channel to a point approximately 50 feet downstream of the intersection. The drainage channel has an asphalt surface with soil deposited at depressions in the channel. Sample MTL SB010 was relocated because no soil was present at the proposed location.

### **9.5 CHEMICAL CHARACTERIZATION**

This section presents the results of chemical analyses for soil samples collected at Site 27. Soil samples collected during the RI at Site 27 were submitted for the laboratory analyses described in Section 9.4 above and as presented in Table 9-2. The analytical results of soil sampling are presented in Appendix J and are compared to the PRGs established for residential soils (EPA 1995; Appendix L). The soil results are also compared to TTLC values defined in Title 22 of the California Code of Regulations. TTLC values are used to categorize waste. If concentrations exceed the TTLC values, then the waste

is defined to exhibit the characteristic of toxicity. In this RI, the TTLC values are not used to characterize waste, but instead are used to compare to soil concentrations to locate any hot spots (areas of unusually high concentrations). The chemicals with concentrations exceeding these criteria are the only chemicals discussed in the following section, and these chemicals are carried into the HHRA. There are no established PRG values for TPH constituents. Organic compounds detected in soils at concentrations exceeding PRGs, as well as all detections of TPH compounds, are shown on Figure 9-5. No organic compounds were detected in soil samples collected at the site at concentrations exceeding TTLC values.

#### **9.5.1 VOCs and SVOCs**

No VOCs were detected in subsurface samples collected in the drainage swale. No SVOCs were detected at concentrations exceeding the PRG values (Table 9-3). Seven SVOCs were detected in building perimeter sample MTL SB017. Surface soil samples collected at MTL SB023 and MTL SB025 (swale bottom), MTL SB014 (building perimeter), and MTL SB015 (drainage channel) contained one or two detected SVOCs (Table 9-3). The presence of pentachlorophenol (PCP) in building perimeter sample MTL SB017 suggests its use as a insecticidal wood preservative at that location; otherwise, the SVOCs detected at the site do not exhibit any distinct pattern of distribution.

#### **9.5.2 Pesticides and PCBs**

Pesticides were detected at concentrations exceeding the PRG values only in surface soil samples collected from building perimeter locations MTL SB014, MTL SB017, and MTL SB018 (Table 9-4). Alpha-chlordane and gamma-chlordane were detected in these samples at concentrations up to 24 mg/kg and 23 mg/kg, respectively (location MTL SB014), which exceed the chlordane PRG value of 0.34 mg/kg. Alpha- and gamma-chlordane were detected in the majority of the samples collected from the other site areas, including the ambient area, although all concentrations were less than or equal to 0.1 mg/kg. These detections of alpha- and gamma-chlordane were highest in the three swale bank samples; otherwise, no other distinct distribution patterns were observed. Concentrations of alpha-chlordane and gamma-chlordane were similar for each sample (Table 9-4).

The pesticide 4,4'-DDD was detected in soils collected at two building perimeter locations, MTL SB017 and MTL SB018, at concentrations of 2 mg/kg and 8 mg/kg, respectively; both exceed the PRG value

of 1.9 mg/kg. Other DDT compounds were detected in the three swale bank samples at concentrations equal to or less than 0.05 mg/kg, which is less than the PRG value. Dieldrin and endosulfan were each detected in one swale bottom surface sample (MTLSB024 at 0.006 mg/kg for dieldrin and MTLSB013 at 0.02 mg/kg for endosulfan), which are less than PRG values. No other pesticides were detected in any of the samples.

PCBs were detected in five samples at concentrations exceeding the PRG for total PCBs of 0.06 mg/kg. The highest concentrations of Aroclors were detected in swale bank surface sample MTLSB013, where Aroclor 1248 and 1254 were detected at concentrations of 0.5 and 1.0 mg/kg, respectively. Concentrations of Aroclor 1248 and 1254 also exceeded the PRG in drainage channel surface sample MTLSB010 (0.4 and 0.5 mg/kg, respectively), and swale bottom surface samples MTLSB024 (0.1 and 0.2 mg/kg, respectively) and MTLSB025 (0.2 and 0.1 mg/kg, respectively). Ambient surface sample MTLSB020 also contained Aroclor 1254 at a concentration of 0.3 mg/kg. Aroclor 1248 concentrations less than the PRG value were found in ambient sample MTLSB021 and swale bottom sample MTLSB024, collected at a depth of 3.0 to 4.0 feet bgs (0.04 and 0.05 mg/kg, respectively). No PCBs were detected in the samples collected around the building perimeters. No other Aroclor congeners were detected in the samples. Aroclors have had diverse applications including use as electrical transformer fluid, hydraulic fluids, cutting oils, and pesticide extenders.

### **9.5.3 TPH Constituents**

TPH-motor oil was detected in samples collected from all sampling locations (Table 9-5). The highest concentration of TPH-motor oil, 12,000 mg/kg, was detected in surface sample MTLSB018, collected at the Building IA-36 UST. TPH-D was also detected in this sample at a concentration of 540 mg/kg. Soil sample MTLSB015, collected 30 feet north of surface sample MTLSB018, contained TPH-motor oil and TPH-D at concentrations 7,400 and 2,700 mg/kg, respectively. The other building perimeter samples, MTLSB014, MTLSB017, and MTLSB019 contained TPH-motor oil at concentrations of 630, 470, and 320 mg/kg, respectively. Drainage channel samples MTLSB016 and MTLSB010 contained TPH-motor oil at concentrations of 190 and 700 mg/kg, respectively. No other samples collected at the site contained TPH-motor oil at concentrations exceeding 77 mg/kg. The maximum ambient sample concentration was 39 mg/kg (MTLSB021).

At sample location MTL SB018, TPH-motor oil and diesel in the soil are likely the result of fuel handling practices at the diesel UST. Elevated TPH detections at swale berm sample MTL SB015 may be the result of fuel oil handling. The swale bottom may have lower concentrations of hydrocarbons because the area most affected by hydrocarbons drains toward the south and west, away from the swale. TPH in the drainage channel may be the result of runoff from H Avenue or the building area of the site via the parking area and H Avenue, rather than via the swale bottom, which has relatively low TPH concentrations. TPH-D concentrations in the ambient soil may be the result of soil disking around the site, which is used to create fire breaks along the perimeters of open, grassy areas. Disking may transport soils from contaminated areas to clean areas.

#### **9.5.4 Summary of Chemical Characterization**

As stated in Section 9.4, Site 27 was divided into four study areas to assess the spatial extent of chemicals at the site. This section summarizes the organic chemicals detected within the three study areas associated with site activities and drainage. The fourth area contained the locations of the ambient soil samples. A summary of analytical results relating to the site as a whole is presented prior to the summary of the analytical results from the study areas.

OC Pesticides and TPH-motor oil were detected in the majority of soil samples collected at the site.

##### **Drainage Swale**

Pesticide concentrations are not significantly greater in the swale bottom than in the ambient samples, indicating that pesticides were probably not disposed of in the swale. The highest PCB concentrations were found in samples collected from the swale berm (up to 1.0 mg/kg Aroclor 1254 in sample MTL SB013), which exceeds the PRG value. TPH-motor oil and diesel were detected at elevated levels in a swale berm sample, potentially associated with releases at the Building IA-36 UST or possibly with surface dumping. The swale bottom has been relatively unaffected by TPH.

##### **Drainage Channel**

Pesticide concentrations are not significantly greater in the drainage channel than in the ambient samples, indicating that pesticides were probably not disposed of in the swale. PCBs were detected in

samples collected from the drainage channel at concentrations exceeding the PRG value (0.5 mg/kg Aroclor 1254 in sample MTL SB010). TPH-motor oil in the drainage channel samples may be the result of either the motor oil at the site or of surface runoff from the parking areas and roads near the site.

#### **Building IA-20 and IA-36 Perimeters**

Chlordane isomers and 4,4'-DDT were detected in samples collected from areas around Building IA-20 and IA-36 at concentrations exceeding PRGs. The compounds 4,4'-DDT and alpha-chlordane were detected at concentrations of 8 and 13 mg/kg, respectively, in sample MTL SB018, collected next to Building IA-36. Pesticide concentrations diminish with distance from the building areas. Conversely, PCBs were not detected in the building perimeter soil samples. Low levels of SVOCs (less than PRG values) in the building perimeter area may indicate use of wood preservatives and insecticides. Fuel handling in the area of the Building IA-36 is likely the source of hydrocarbons at sample location MTL SB018, where TPH-motor oil concentrations were 12,000 mg/kg. The Building IA-36 UST is slated for removal under the UST removal program at NWS Concord.

#### **Ambient Locations**

PCBs were detected in samples collected from ambient area at concentrations exceeding the PRG value (0.3 mg/kg Aroclor 1254 in MTL SB020). Low levels of TPH were also detected in the ambient soils.

### **9.6 REVISED CONCEPTUAL SITE MODEL**

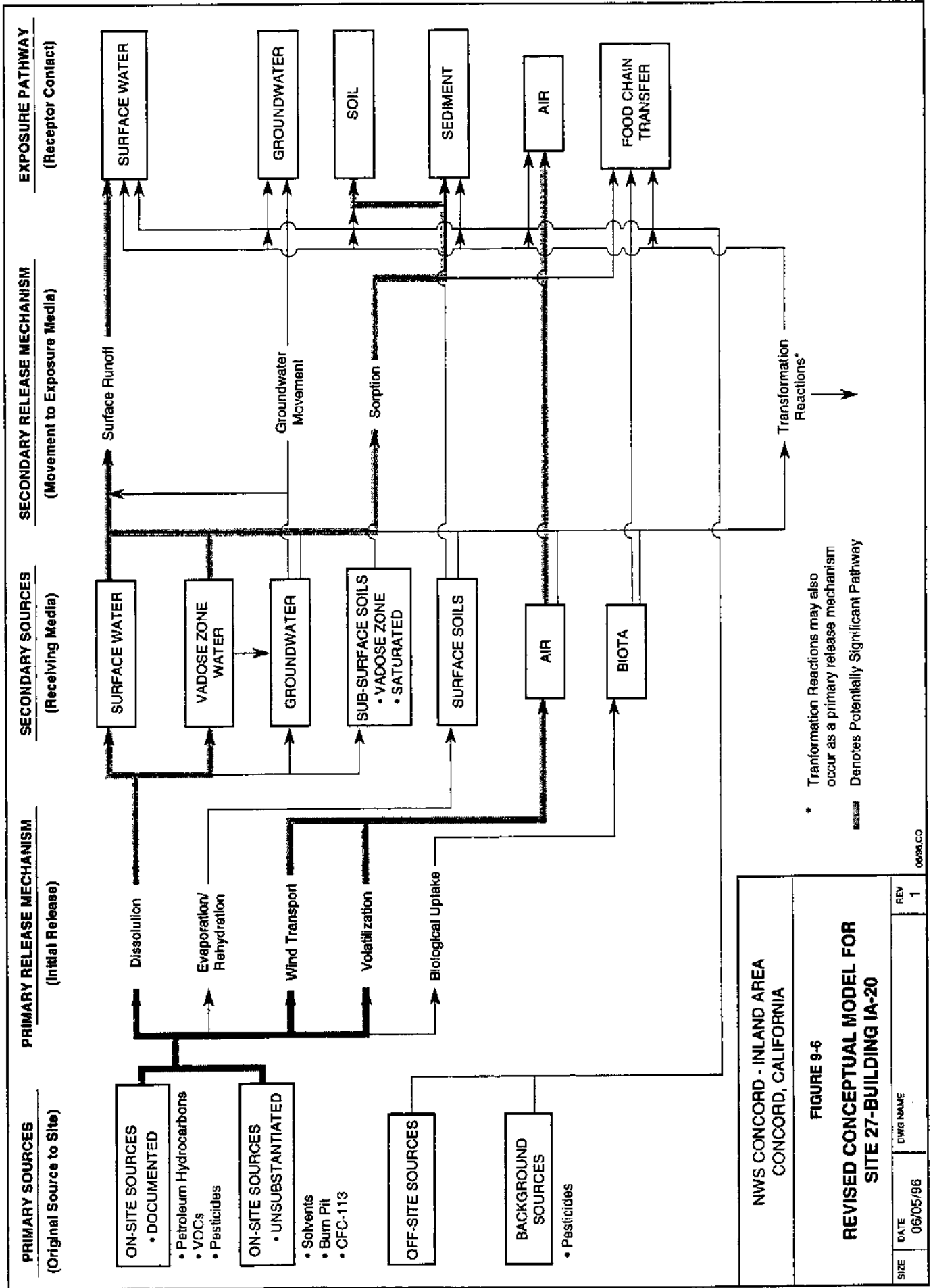
The conceptual site model was developed after the SI and is presented in the WP (PRC/Montgomery Watson 1995a). This conceptual site model has been updated to include the RI data. The model lists potential sources and COPCs identified in Section 9.5, and highlights the most likely migration routes (Figure 9-6). The model is used in conjunction with the results from the human health and ecological risk assessments and the fate and transport properties of the COPCs to assess site conditions and the need for remediation. The area defined as Site 27 is located around several buildings and upslope from the buildings where grading has occurred. The SI at this site was conducted to evaluate the alleged disposal and reported cleanup of solvent wastes from the chemical laboratory. Although no chemicals related to potential solvent disposal were found in the SI or RI, petroleum hydrocarbons were found in several soil samples, and these detections may be related to an UST that has been identified as leaking,



or spills resulting from use of the UST. Chlorinated pesticides were detected in surface soils around the buildings, and it is believed that these pesticides are present because of application for insect control. PCBs were detected in soil samples from ambient locations on the hillside, in the drainage ditch, and from the swale. The source of the PCBs is unknown. The major chemical migration pathway is considered to be via sediment moving west through the graded drainage swale behind the buildings and then in a northerly direction down a drainage course along the east side of H Street. The wind transport and volatilization pathways are not significant, because no VOCs were detected at Site 27 during the RI.

## Figures 9-1 - 9-5

These detailed station maps have been deleted from the Internet-accessible version of this document as per Department of the Navy Internet security regulations.



NWS CONCORD - INLAND AREA CONCORD, CALIFORNIA			
FIGURE 9-6 REVISED CONCEPTUAL MODEL FOR SITE 27-BUILDING 1A-20			
SIZE	DATE	DWG NAME	REV
	06/05/96		1

TABLE 9-1

**REMEDIAL INVESTIGATION  
SUMMARY OF GEOTECHNICAL TESTING RESULTS  
SITE 27 - BUILDING 1A-20  
WPNSTA CONCORD**

Laboratory Identification	Soil Sample Location	Sample Interval (feet bgs)	Grain Size	USCS Symbol	Permeability (cm/sec)	Porosity (%)	Density lb/ft <sup>3</sup>	Specific Gravity	Moisture (%)
TL002	MTLSB023	3.0-4.0	Sandy clay	~~	2.00E-05	39.74	105.3	2.80	17.6
TL004	MTLSB024	3.0-4.0	Sandy clay	~~	6.00E-08	38.69	104.4	2.73	20.7
TL006	MTLSB025	3.0-4.0	Sandy clay	~~	2.00E-06	40.20	100.4	2.69	20.3
~~ - Information not provided by testing laboratory									

TABLE 9-2

**SUMMARY OF SOIL ANALYSES, SITE 27  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

Sample Location	Matrix	Sample Depth	Organic Compounds					Other Parameters			
			Pesticide/PCB	CLP SVOC	Low Level SVOC	TPH Extractable	VOCs	Geophys. Param.	Grain Size	Percent Moisture	TOC
MTLSB010	Soil	0 - .5	1	1	1	1	1			1	
MTLSB011	Soil	0 - .5	1	1	1	1	1				
MTLSB012	Soil	0 - .5	1	1	1	1	1				
MTLSB013	Soil	0 - .5	1	1	1	1	1				
MTLSB014	Soil	0 - .5	1	1	1	1	1				
MTLSB015	Soil	0 - .5	1	1	1	1	1				
MTLSB016	Soil	0 - .5	1	1	1	1	1			1	
MTLSB017	Soil	0 - .5	1	1	1	1	1				
MTLSB018	Soil	0 - .5	1	1	1	1	1				
MTLSB019	Soil	0 - .5	1	1	1	1	1				
MTLSB020	Soil	0 - .5	1	1	1	1	1				
MTLSB021	Soil	0 - .5	1	1	1	1	1				
MTLSB022	Soil	0 - .5	1	1	1	1	1				
MTLSB023	Soil	0 - .5	1	1	1	1	1				1
	Soil	3 - 4	1	1	1	1	1	1	1		
MTLSB024	Soil	0 - .5	1	1	1	1	1				
	Soil	3 - 4	1	1	1	1	1	1	1	1	1
MTLSB025	Soil	0 - .5	1	1	1	1	1				
	Soil	3 - 4	1	1	1	1	1	1	1	1	1
<b>Total:</b>			<b>19</b>	<b>19</b>	<b>19</b>	<b>2</b>	<b>19</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>3</b>

Note:

Section 3.0 tables list the analytical methods used and Appendix I, Quality Control Summary Report, describes quality assurance samples.

TABLE 9-3

**SUMMARY OF DETECTED SVOCs IN SOIL**  
**SITE 27 - BUILDING IA-20**  
**INLAND AREA REMEDIAL INVESTIGATION**  
**NWS CONCORD**

Sample Location	Investigation	Sample Depth (ft bgs)	Benzo(a)anthracene	Benzo(a)pyrene	Benzo(b)fluoranthene	Chrysene	Fluoranthene	Phenol	Pyrene	N-Nitrosodiphenylamine	Benzo(g,h,i)perylene	Benzo(k)fluoranthene	Indeno(1,2,3-cd)pyrene	Pentachlorophenol	High Molecular Weight PAHs	Low Molecular Weight PAHs	Total PAHs
Residential PRGs (mg/kg)			0.61	0.061	0.61	6.1	2,600	39,000	100	91	NE	0.61	0.61	2.5	NE	NE	NE
Concentration (mg/kg)																	
MTLSB010	RI	0 - .5	0.028	0.023	0.018	0.03	--	--	--	--	0.026	0.019	--	--	0.118	0.028	0.146
MTLSB014	RI	0 - .5	--	--	--	0.024	--	--	--	0.15	--	--	--	--	0.024	--	0.024
MTLSB016	RI	0 - .5	--	--	--	--	0.028	--	0.021	--	--	--	--	--	0.049	--	0.049
MTLSB017	RI	0 - .5	--	--	0.024	0.033	0.038	--	0.031	--	0.035	--	0.019	0.078	0.145	--	0.145
MTLSB023	RI	0 - .5	--	--	--	--	--	0.38	--	--	--	--	--	--	--	--	--
MTLSB025	RI	0 - .5	--	--	--	--	--	0.27	--	--	--	--	--	--	--	--	--

NE - Not Established

Concentrations shown in **bold** exceed the residential PRG.

Appendix J contains full analytical tables which include the date sampled, samples with nondetected concentrations, and detection limits.

TABLE 9-4

**SUMMARY OF DETECTED PESTICIDES AND PCBS IN SOIL,  
SITE 27 - BUILDING IA-20  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

Sample Location	Investigation	Sample Depth (ft bgs)	4,4'-DDD	4,4'-DDE	4,4'-DDT	Alpha-Chlordane	Aroclor-1248 <sup>a</sup>	Aroclor-1254 <sup>a</sup>	Dieldrin	Endosulfan	Gamma-Chlordane	Heptachlor Epoxide	Total DDTs
Residential PRGs (mg/kg)			1.9	1.3	1.3	0.34	NE	1.4	0.028	390	0.34	0.049	NE
Concentration (mg/kg)													
MTLSB010	RI	0 - .5	--	--	--	0.012	0.39	0.45	--	--	--	--	0
MTLSB012	RI	0 - .5	0.058	0.031	--	0.045	--	--	--	--	0.035	--	0.089
MTLSB013	RI	0 - .5	--	--	0.014	0.049	0.5	1	--	0.024	0.021	--	0.014
MTLSB014	RI	0 - .5	--	--	--	24	--	--	--	--	23	--	0
MTLSB015	RI	0 - .5	0.05	--	--	0.1	--	--	--	--	0.1	--	0.05
MTLSB016	RI	0 - .5	--	--	--	0.0014	--	--	--	--	0.0014	--	0
MTLSB017	RI	0 - .5	2	--	--	4.3	--	--	--	--	4.3	--	2
MTLSB018	RI	0 - .5	8.2	--	--	13	--	--	--	--	12	--	8.2
MTLSB019	RI	0 - .5	--	--	--	0.015	--	--	--	--	0.018	--	0
MTLSB020	RI	0 - .5	--	--	--	0.0086	--	0.28	--	--	0.0031	--	0
MTLSB021	RI	0 - .5	--	--	--	--	0.036	--	--	--	0.0024	--	0
MTLSB024	RI	0 - .5	--	--	--	0.0064	0.11	0.15	0.0055	--	--	--	0
	RI	3 - 4	--	--	--	--	0.049	--	--	--	--	--	0
MTLSB025	RI	0 - .5	--	--	--	0.0065	0.18	0.12	--	--	--	--	0

NE - Not Established

Concentrations shown in **bold** exceed the residential PRG.

Appendix J contains full analytical tables which include the date sampled, samples with nondetected concentrations, and detection limits.

<sup>a</sup> The PRG for total PCBs is 0.066 mg/kg.

**TABLE 9-5**

**SUMMARY OF DETECTED TPH IN SOIL  
SITE 27 - BUILDING IA-20  
INLAND AREA REMEDIAL INVESTIGATION  
NWS CONCORD**

Sample Location	Investigation	Sample Depth (ft bgs)	Diesel	Motor Oil
Residential PRGs (mg/kg)			NE	NE
			Concentrations (mg/kg)	
MTLSB010	RI	0 - .5	--	700
MTLSB011	RI	0 - .5	--	38
MTLSB012	RI	0 - .5	--	77
MTLSB013	RI	0 - .5	--	40
MTLSB014	RI	0 - .5	--	630
MTLSB015	RI	0 - .5	2,700	7,400
MTLSB016	RI	0 - .5	--	190
MTLSB017	RI	0 - .5	--	470
MTLSB018	RI	0 - .5	540	12,000
MTLSB019	RI	0 - .5	29	320
MTLSB020	RI	0 - .5	--	21
MTLSB021	RI	0 - .5	--	39
MTLSB022	RI	0 - .5	--	29
MTLSB023	RI	0 - .5	--	63
	RI	3 - 4	--	25
MTLSB024	RI	0 - .5	--	43
MTLSB025	RI	0 - .5	--	34
	RI	3 - 4	--	19

NE - Not Established



## **10.0 HUMAN HEALTH RISK ASSESSMENT**

This section presents the screening-level human health risk assessment (HHRA) for the Naval Weapon Station (NWS) Concord Inland Area sites. The objective of the HHRA was to evaluate potential risks to humans associated with exposure to contaminated media at these sites under current and possible future land-use scenarios, assuming no subsequent cleanup actions will be taken. Each of the Inland Area sites (Site 13 - the Burn Area, Site 17 - Building IA-24, Site 22 - Building 7SH5, Site 24A - the Pistol Firing Range, and Site 27 - Building IA-20) was evaluated separately. The HHRA is based on the site characterization and sampling data presented in Sections 5.0 through 9.0 of this report.

The media evaluated in the HHRA were soil, sediment, and groundwater. Potential carcinogenic risks and noncarcinogenic hazards associated with these media were calculated using a screening-level approach. Specifically, contaminant concentrations were compared with U. S. Environmental Protection Agency (EPA) Region IX preliminary remediation goals (PRG) (EPA 1996b). The HHRA scope and methodology were developed in consultation with EPA and the Department of Toxic Substances Control (DTSC), and were summarized in the revised HHRA approach document (PRC 1996b) for agency review. The HHRA approach is consistent with the memorandum regarding the recommended outline for using EPA Region IX PRGs in screening risk assessments at military facilities (DTSC 1994b).

This chapter is organized to reflect the four basic steps of a risk assessment as follows: Section 10.1, Data Evaluation and Identification of Chemicals of Potential Concern; Section 10.2, Exposure Assessment; Section 10.3, Toxicity Assessment; and Section 10.4, Risk Characterization. The risk characterization results for each of the NWS Concord Inland Area sites is summarized in Section 13 of this RI report. Section 13 also presents recommendations for each site evaluated in this RI.

### **10.1 DATA EVALUATION AND IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN**

This section describes the available analytical data and the approach that was used to evaluate data quality and usability for risk assessment purposes. This section also discusses the process that was used to identify chemicals of potential concern (COPCs), the constituents carried through the risk assessment.

#### **10.1.1 Human Health Risk Assessment Data**

The available analytical data for the Inland Area sites includes results from the site investigation (SI), the solid waste management unit (SWMU) investigations, the remedial investigation (RI), and the Site 13 Confirmation Sampling, as presented in Sections 5.0 through 9.0 of this report. The analytical data are presented in Appendix J. These studies are briefly summarized in the following subsections.

##### **10.1.1.1 Site Investigation**

The SI conducted at the Inland Area sites during June and July 1992 entailed the collection of soil samples at all sites and groundwater samples at Sites 13 and 17. Both soil and groundwater samples were analyzed for volatile organic compounds (VOC), semivolatile organic compounds (SVOC), pesticides, polychlorinated biphenyls (PCB), total petroleum hydrocarbons (TPH), explosive compounds, and metals. Results of the sampling effort were documented in the SI report (PRC/Montgomery Watson 1993a), and are summarized in the site-specific sections of this RI report (Sections 5.0 through 9.0).

##### **10.1.1.2 Solid Waste Management Unit Investigations**

Investigations of SWMUs 12/20 and 52, which are part of Sites 17 and 22, respectively, were conducted in March 1995. Soil samples were collected at each site and analyzed for VOCs, SVOCs, metals, and oil and grease. Results of these analyses are presented in the site-specific sections of the RI report (Sections 6.0 and 7.0).

##### **10.1.1.3 Remedial Investigation**

As part of the RI of the Inland Area sites, soil, sediment, and groundwater samples were collected in April and May 1995. The samples were analyzed for VOCs, SVOCs, pesticides, PCBs, TPH-extractables, TPH-purgeables, metals, dioxins, and hexavalent chromium. Sections 5.0 through 9.0 of this report summarize the results of this investigation.

##### **10.1.1.4 Site 13 Confirmation Sampling**

Results from the RI for Site 13 showed lead present in two trench locations at concentrations of 5,590 milligrams per kilogram (mg/kg) and 3,090 mg/kg. Based on these results, confirmation samples were collected in February 1996 in an effort to confirm the presence and assess the extent of the previously detected lead. The confirmation samples, however, contained lower concentrations of

lead than those reportedly detected in the RI samples. The concentrations ranged from 4.9 mg/kg to 235 mg/kg. The results of this study are discussed in Section 5.5.1.2 of this report, and the concentrations are shown on Figure 5-14. Complete analytical results from the confirmation study are presented in Appendix J.

#### 10.1.2 Data Evaluation

A rigorous evaluation of the RI sampling and analysis methodology employed at the NWS Concord Inland Area sites was carried out to verify that the quality of the sampling data was acceptable for use in a quantitative risk assessment. Data validation of these samples followed EPA data validation guidelines (EPA 1994a and 1994b), as described in the quality assurance project plan (QAPjP) (PRC/Montgomery Watson 1995c). To summarize the data validation process, all RI data were subject to a cursory review, and 10 percent of the data was fully validated. The cursory review evaluated the effects of the most critical quality assurance and quality control (QA/QC) information, such as holding times, calibration requirements, and spiking accuracy, on the data. The full review evaluated additional QA/QC criteria and used the raw data to check calculations and analyte identifications. The overall objective of data validation was to ensure that the quality of the analytical data were adequate for their intended purposes, as defined by the following parameters: precision, accuracy, representativeness, completeness, and comparability (PARCC). At each stage of the validation, qualifiers were assigned to the results according to EPA guidelines (EPA 1994a and 1994b), the QAPjP (PRC/Montgomery Watson 1995c), and the associated analytical methods.

The data validation results are documented in a quality control summary report (QCSR) presented in Appendix I of this report. The QCSR includes a discussion of the PARCC parameters, an evaluation of how well the data met the PARCC parameter goals established in the QAPjP, and a summary of how meeting these PARCC goals helps achieve the data quality objectives (DQOs) for the RI. The RI data were found to meet all requirements of "definitive data" as described in *Data Quality Objectives Process for Superfund* (EPA 1993a). Definitive data are generated using rigorous analytical methods, such as approved EPA reference methods. Definitive data are also analyte-specific, with confirmation of analyte identity and concentration (EPA 1993a). All data without qualifiers and all data qualified as estimated (J) were used in the risk assessment. The nondetected data (U) were also incorporated into the risk assessment by using a proxy value of one-half the sample quantitation limit. Only data qualified as rejected (R) were considered unusable for risk assessment purposes (EPA 1989d and 1992b).

General data quality issues of particular concern for the risk assessment are summarized below. As indicated in the QCSR (Appendix I), no site-specific data quality problems were encountered during the

RI; accordingly, QA/QC program results are not discussed on a site-by-site basis.

Certain VOCs, SVOCs, metals, pesticides, and PCB isomers have been qualified as nondetected (U) as a result of blank contamination. Further information on blank contamination is presented in Appendix I.

As part of the data evaluation process, the sample detection limits (DL) (for inorganic analytes) and sample quantitation limits (SQL) (for organic analytes) were compared to soil and water PRGs for residential land use (EPA 1996b). For some constituents, the DL or SQL was typically greater than the corresponding PRG. In those cases, the constituents may have been present at concentrations posing a potential health risk, but would not have been reported. The groundwater constituents with DLs or SQLs above PRGs were vinyl chloride, certain phenylamine, propylamine, ether, and hexachlorobenzene compounds, and the metals arsenic, beryllium, and cadmium. Of the soil analyses, only n-nitrosodiphenylamine had a DL above the residential PRG. For all of these groundwater and soil analytes with DLs or SQLs above PRGs, however, lower DLs and SQLs are not routinely attainable using conventional analytical techniques.

#### **10.1.3 Identification of Chemicals of Potential Concern in Soil**

COPCs were identified following a three-step process. First, the validated soil analytical data were assembled by site and depth interval, and a preliminary list of all analytes detected in one or more soil samples was developed for each site and depth interval. A list of all analytes detected at each site is presented in summary statistics tables presented in Appendix K. Second, select metals were removed from the lists on the basis of a comparison with ambient levels. Third, elements considered essential human nutrients (calcium, iron, magnesium, potassium, and sodium) were removed from the lists. All remaining constituents on the list for each site, except TPH, were considered COPCs and therefore evaluated in the risk assessment. Evaluation of TPH is discussed in Section 10.3.2. The screening procedures that were employed (the second and third steps) are described in greater detail below, followed by a discussion of the metals at each site that were eliminated from further consideration as soil COPCs.

### 10.1.3.1 Comparison With Ambient Levels

Metal concentrations in soil samples collected from each site (except Site 27) were compared to ambient levels estimated for the NWS Concord Inland Area sites to determine whether they should be considered COPCs. Two sets of ambient levels were established for this comparison because there are two different geologic formations in the study area (Appendix A). Soils at Sites 13 and 22 are from the Los Medanos Hills Formation, while soils at Sites 17 and 24A were formed from the Tertiary Sedimentary Formation. Ambient levels were not established for Site 27 because prior investigations indicated that no source for metals exists at the site.

As described in Appendix A, statistical procedures used to derive the two sets of ambient levels were not identical because the numbers of samples composing the ambient data set for each material were significantly different. For the Los Medanos Hills Formation (underlying Sites 13 and 22), where more than 20 samples were previously collected, ambient levels were computed as the 95<sup>th</sup> percentile of the ambient data set. For the Tertiary Sedimentary Formation (underlying Sites 17 and 24A), however, where the limited number of samples precluded a statistical approach, the ambient levels were set equal to the maximum detected concentration of each metal. This approach was developed in consultation with the regulatory agencies. Uncertainties associated with use of this approach in the risk assessment are discussed in Section 10.4.4.

Using the ambient levels for Sites 13 and 22, the screening process to determine whether a particular metal should be considered a COPC for a site had three possible outcomes, as specified below:

1. **All site concentrations of the metal were less than the ambient level.** The metal was assumed to be unrelated to site activities and was excluded from further consideration in the risk assessment.
2. **Less than 5 percent of the site samples contained the metal at concentrations greater than the ambient level.** The metal was excluded, but depending on the distribution of exceeded concentrations, it may be cited as a source of uncertainty in the risk assessment.
3. **More than 5 percent of the site samples contained the metal at concentrations greater than the ambient concentration.** The metal was retained as a COPC.

Since the ambient levels for Sites 17 and 24A were equal to the maximum detected concentration of each metal in the ambient data set, screening for these sites entailed a direct comparison only. For these sites, if a concentration greater than that ambient level was detected in one or more site soil samples, the metal was retained in the risk assessment.

#### 10.1.3.2 Excluded Metals for Inland Areas Sites

For each of the Inland Area sites, the screening process led to exclusion of certain metals from further consideration in the risk assessment. Results are described on a site-by-site basis below.

**Site 13 - Burn Area.** Arsenic, thallium, and vanadium were excluded on the basis of comparison with the Los Medanos Hills Formation ambient levels.

Excluded Metal	Ambient Level (mg/kg)	Frequency of Detection at Concentrations > Ambient	Percentage of Detects at Concentrations > Ambient
Arsenic	10	7/164	4.3
Thallium	1.9	1/164	< 1
Vanadium	96	4/164	2.4

**Site 17 - Building IA-24.** Arsenic and thallium were excluded because none of the site concentrations was greater than the ambient levels for the Tertiary Sedimentary Formation.

**Site 22 - Building 7SH5.** Barium, manganese, and thallium were excluded on the basis of a comparison with the Los Medanos Hills Formation ambient levels. None of the site samples contained these metals at concentrations greater than ambient levels.

**Site 24A - Pistol Firing Range.** Aluminum, cobalt, manganese, mercury, thallium, and vanadium were excluded because none of the site concentrations was greater than the Tertiary Sedimentary Formation ambient levels.

**Site 27 - Building IA-20.** Analyses for metals was not performed for soil samples collected at Site 27 because historical information and analytical results from prior investigations indicated that no source for metals exists at the site.

#### 10.1.4 Identification of Chemicals of Potential Concern in Other Media

For groundwater and sediment, all detected analytes were retained as COPCs except TPH (refer to Section 10.3.2). Although some of the detected analytes occur naturally in groundwater and sediment (for example, metals), ambient levels have not been established for analytes in these two media, and no formal screening process could be conducted. A list of all analytes detected in sediment samples collected at Site 17 and those detected in groundwater samples collected at Sites 13, 17, and 22 are presented in statistical summary tables in Appendix K.

## **10.2 EXPOSURE ASSESSMENT**

The exposure assessment evaluates the nature and magnitude of potential exposures associated with the site. The assessment includes a description of the exposure setting and land use, the identification of potential receptors and exposure pathways, and the estimation of exposure point concentrations.

### **10.2.1 Exposure Setting and Land Use**

The exposure setting at the NWS Concord Inland Area sites, including land use, climate, topography, geology, and hydrology is described in Sections 5.1, 6.1, 7.1, 8.1, and 9.1 of this report. The Inland Area encompasses about 6,200 acres of flatlands and low rolling hills.

NWS Concord is an open naval base and is not scheduled to close. Current activities at NWS Concord Inland Areas sites are limited to industrial operations and maintenance activities performed by base personnel. Current land use is considered on a site-specific basis to identify current receptors and exposure pathways described in Section 10.2.2. Land use in the area around NWS Concord is diverse, characterized by a mixture of military, industrial, residential, agricultural, and open space zones. The closest civilian, residential communities are Clyde, which is approximately 1/4 mile north of NSW Concord's front gate, and Concord, which is adjacent to NWS Concord Inland Area's western boundary.

Future land use at the NWS Concord Inland Areas sites is not expected to change from its current use. Future residential, recreational, or private industrial or commercial use of the sites is therefore not anticipated. However, although very unlikely, it was conservatively assumed that land use is unrestricted in the future and that residential developments are constructed at the site. An unrestricted land-use scenario generally provides the greatest potential for exposure to site contaminants. Sites found to have acceptable risk for this scenario will also have acceptable risk for other uses, such as industrial or recreational. The residential PRGs are used to evaluate this more conservative (health-protective) land use scenario.

### **10.2.2 Receptors and Exposure Pathways**

This section summarizes the potential receptors, exposure pathways, and exposure routes evaluated for each site in the Inland Area. A general conceptual site model (CSM) (Figure 10-1) identifies source types, exposure routes, and receptors for the NWS Concord Inland Area sites, while CSMs presented in Sections 5.6, 6.6, 7.6, 8.6, and 9.6 identify site-specific exposure pathways.

The selection of current receptors is based on current land use and most probable current activities at each site. For all sites, the primary receptors identified were base personnel. For purposes of this risk assessment, activities of base personnel were assumed to be similar to an industrial worker as defined by the EPA Region IX PRG document. At some sites, base visitors were also identified as potential receptors. A separate screening-level assessment of risks for this receptor was not made because the exposure and risk estimates for an industrial worker are expected to provide an upper bound estimate of risks for a visitor. The exposure pathways evaluated for an industrial worker are consistent with the EPA Region IX PRGs and include incidental ingestion of soil, dermal contact with soil, and inhalation of airborne particulates and volatile compounds released from soil. The industrial soil PRGs (EPA 1996b) were used to assess risk associated with industrial worker exposure to COPCs identified at the site.

Probable future receptors were identified based on projected future land use and probable future activity patterns at each site. For all sites, the most probable future receptors are base personnel; however, as indicated in Section 10.2.1, a residential scenario was evaluated for each site. Potential impacts to residents were assessed for three exposure pathways: incidental ingestion of soil, dermal contact with soil, and inhalation of airborne particulates and volatile compounds released from soil. For all sites, the residential soil PRGs were used to assess risk associated with residential exposure to COPCs via these pathways. At Site 17, residential exposure to metal COPCs identified in sediment was also evaluated using the residential soil PRGs. In addition, residential exposure to chemicals detected in groundwater could occur if groundwater resources on the sites were developed in the future. Currently, most private and city municipal water in the region is supplied by treated surface water sources. For Sites 13, 17, and 22, the tap water PRGs were used to assess risks and hazards associated with potential residential exposure to COPCs in groundwater via the ingestion and inhalation of volatile compounds exposure pathways.

The frequency and duration of exposure assumed for each receptor identified in this HHRA are specifically defined in the EPA Region IX PRGs memorandum (EPA 1996b), which is included in Appendix L. Activities performed on the NWS Concord Inland Area sites are summarized in the following subsections, primarily focusing on base personnel activities.

#### **10.2.2.1 Site 13 - the Burn Area**

The Burn Area site is part of an agricultural outlease for cattle grazing. There are normally no personnel on the site. Infrequent and short-duration visits to the site are made by the lessee and the natural resources manager for the station. There is no specific recreational use of the site, and



trespassers have not been known to cross the site. The nearest off-base residences are located on San Vincente and Natoma drives, about 1,250 feet from the site. The nearest on-station residences are about 2,400 feet from the site. The Navy has no plans to change the use of the site.

EPA Region IX does not currently have PRGs available to evaluate ingestion of meat or dairy products, and potential health risks from the use of Site 13 for cattle grazing were not quantified.

#### **10.2.2.2 Site 17 - Building IA-24**

Approximately 7 to 12 personnel each work about 40 hours per week at Building IA-24. Activities in the vicinity of the building include forklift maintenance operations and truck parking. There are no recreational users at the site, and no trespassers are known to have entered the site. The site is about 4,000 feet from the nearest off-station residences (vicinity of Lynwood Drive, Lynwood Court, and Sequoia Court). The nearest Navy-owned residences are about 9,600 feet from the site. There are no plans to change the use of the site.

#### **10.2.2.3 Site 22 - Building 7SH5**

Three personnel work in Building 7SH5 for 40 hours per week manufacturing mobile laboratories to be used during explosive ordnance disposal (EOD) activities. No recreational use of Building 7SH5 occurs, and no known trespassing at Building 7SH5 has occurred. Site 22 is about 330 feet from the nearest off-station residence (on Lynwood Drive or Elwood Court) and about 8,800 feet from the nearest on-station residence. The Navy has no plans to change the use of the site.

#### **10.2.2.4 Site 24A - Pistol Firing Range Site**

Approximately 170 personnel use the Pistol Firing Range for two training events per year. Almost all of the personnel spend between 15 to 20 hours per year on the range; two instructors each spend 240 to 300 hours per year on the range. There is no recreational use of the pistol range, and no trespassers have been known to enter the site. The nearest off-station residence is about 5,100 feet from the site (located at Lynwood Drive or Elwood Court), and the nearest on-station residence is about 11,000 feet from the site. The Navy has no plans to change the use of the site.

#### **10.2.2.5 Site 27 - Building IA-20**

Two personnel usually work at Building IA-20 for 40 hours per week. The building houses the chemical laboratory and a materials testing laboratory. There is no recreational use of the site, and

trespassing at the site has not been known to occur. The nearest off-station residence, an isolated home located off Evora Road, is about 2,100 feet from the site. The nearest on-station residences are the active duty military barracks, about 2,100 feet from the site. The Navy does not have any plans to change the use of the site.

### **10.2.3 Exposure Point Concentrations**

For each site in the NWS Concord Inland Areas, COPC concentrations (referred to as exposure point concentrations) were estimated for soil. Exposure point concentrations were also estimated for sediment evaluated at Site 17 and for groundwater at Sites 13, 17, and 22. For all media, exposure point concentrations were calculated using analytical data obtained during the SI, SWMU investigations, RI, and Site 13 confirmation sampling efforts. Uncertainties associated with derivation of exposure point concentrations are discussed in Section 10.4.4.

In consultation with DTSC and EPA, it was determined that use of the upper 95 percent confidence limit on the arithmetic mean (95 UCL) as the exposure point concentration for each COPC was a reasonable approach for the Inland Area sites, given that the number of samples collected at each site were adequate to characterize the nature and extent of chemical contamination. Also, because both purposive and random sampling approaches were applied in the RI to characterize areas that were most likely to be contaminated (based on SI sample results) and to define the extent of contamination in the RI source areas, it is unlikely that areas of significant contamination were not sampled during investigation efforts. The use of 95 UCL concentrations is recommended by EPA (EPA 1992c) for evaluating reasonable maximum exposure (RME) conditions at a site and is consistent with DTSC and EPA guidance for baseline human health risk assessments. RME is defined as the highest exposure that is reasonably expected to occur at a site. Typically, DTSC indicates that the maximum concentration of each contaminant should be used as the exposure point concentration for comparisons against PRGs for screening-level risk assessments (DTSC 1994b). This policy is based on the assumption that few samples would be available for evaluation in a screening-level risk assessment. DTSC indicated that the size of the samples collected at each of the Inland Area sites were large enough to adequately characterize the site. Consequently, the 95 UCL is used as the exposure point concentration for each COPC. For purposes of comparison, the risks and hazards associated with use of maximum concentrations are also presented in Appendix N.

The methods used to calculate exposure point concentrations are presented in Appendix K. The statistical summaries of all analytes detected are also presented in Appendix K. The statistical summaries present the maximum, minimum, average, and 95 UCL concentrations of all analytes detected in soil, sediment, and groundwater. For soil, exposure point concentrations were calculated

for “surface soils” (0 to 0.5 feet bgs) and “subsurface soils” (0 to 10 feet bgs). All sediment data obtained at Site 17 and all groundwater data collected at Sites 13, 17, and 22 were used to calculate the exposure point concentrations used in this HHRA to evaluate potential exposure to these media.

### **10.3 TOXICITY ASSESSMENT**

A toxicity assessment typically includes two components: (1) brief descriptions of the major toxicological effects associated with the chemicals of concern identified at a site (toxicity profiles) and (2) a list of toxicity values (slope factors [SF] and reference doses [RfD]) used in the risk assessment for characterization of risk and hazards. Toxicity profiles for chemicals of concern (COC), defined as chemicals with a risk greater than  $1 \times 10^{-6}$  or a hazard quotient greater than 1, are presented in Appendix M.

Because the NWS Concord Inland Area sites risk assessment is based on comparisons of COPC concentrations with EPA Region IX PRGs (EPA 1996b) instead of on calculations of contaminant intake, toxicity values were not required for the assessment and are not provided. Toxicity values developed by EPA (EPA 1995, 1996a) are used to derive PRGs, and these values are listed in the EPA memorandum regarding the derivation of the Region IX PRGs, presented in Appendix L. Section 10.3.1 describes the source of specific toxicity values used to calculate the PRGs selected for use in this risk assessment, and Section 10.3.2 identifies surrogate PRGs when a value is not available because toxicity values have not been developed by EPA. Uncertainties associated with the toxicity assessment are discussed in Section 10.4.4.

#### **10.3.1 Toxicity Values**

PRGs are health-based concentrations for individual chemicals that are calculated using published toxicity values. PRGs correspond to a risk of  $1 \times 10^{-6}$  or a noncarcinogenic hazard quotient of 1, whichever is lower. In most cases, when exposure to a specific chemical has been associated with both carcinogenic and noncarcinogenic effects, only the more stringent value (typically, the value corresponding to a cancer risk of  $1 \times 10^{-6}$ ) is presented in the printed PRG table. The electronic version of the EPA Region IX PRGs includes PRGs corresponding to the noncarcinogenic effects of carcinogens. Both the carcinogenic and noncarcinogenic PRGs were used, when available.

EPA Region IX PRG tables include California-modified PRGs for benzo(k)fluoranthene, benzo(a)pyrene, cadmium, chrysene, 1,2-dibromo-3-chloropropane, lead, nickel, and tetrachloroethene (EPA 1996b). The California-modified PRGs were used in place of their EPA Region IX PRGs. The EPA Region IX PRGs include California-modified PRGs for the residential scenario only. SFs from

the California Environmental Protection Agency (Cal/EPA) guidance (1994), along with EPA exposure equations and parameters provided with the EPA Region IX PRGs (1996b), were used to calculate California-modified industrial PRGs.

The EPA Region IX PRGs use an SF of 7.7 per mg/kg/day to evaluate the carcinogenic effects from all polychlorinated biphenyls (PCB) isomers. EPA has recently published guidance on evaluating cancer risks from exposure to PCBs (EPA 1996c). This guidance presents a range of PCB central and upper-bound (RME) SFs with three reference points (high-, low-, and lowest-risk and persistence). The highest category slope factor (2.0 per mg/kg/day) is appropriate for evaluation of Aroclor-1248 and Aroclor-1254, detected at the NWS Concord Inland Area sites. This slope factor was used to recalculate the residential PRG (0.25 mg/kg) and the industrial PRG (1.3 mg/kg) for PCBs.

Hexavalent chromium samples were collected and analyzed at Sites 13, 17, 22, and 24A. The percentage of hexavalent chromium samples analyzed at each site ranged from 9 to 21 percent of all site samples that were analyzed for metals. Hexavalent chromium was not detected in any sample, and therefore, all chromium results will be evaluated as trivalent chromium. The trivalent chromium RfD was used to recalculate the PRG for this metal. Uncertainties associated with chromium speciation are discussed in Section 10.4.4.

### **10.3.2 Chemicals With No Toxicity Values**

The Region IX PRGs assume route-to-route extrapolation when no route-specific toxicity values were available. Oral RfDs and SFs are used to derive PRGs when dermal or inhalation toxicity values are not available (EPA 1996b). In addition, inhalation toxicity factors are used to evaluate oral exposure when no oral toxicity values were available.

The following chemicals were detected at the Inland Area sites but do not have toxicity values: 4-nitroaniline, benzo(e)pyrene, benzo(g,h,i)perylene, phenanthrene, 2-methylnaphthalene, and certain inorganic compounds. The pyrene RfD was used as a surrogate for benzo(e)pyrene, benzo(g,h,i)perylene, and phenanthrene. The naphthalene RfD was used as a surrogate for 2-methylnaphthalene. The 2-aniline RfD was used as a surrogate for 4-nitroaniline. These surrogate toxicity values were used to derive PRGs using the EPA Region IX PRG equations presented in Appendix L.

In addition, there are currently no accepted toxicity values for total petroleum hydrocarbons (TPH); however, the Cal/EPA has adopted a constituent-based approach for evaluating the toxicity of petroleum hydrocarbon mixtures (Cal/EPA 1993). This approach involves evaluating the most toxic

constituents of TPH, such as benzene, toluene, ethylbenzene, and xylenes (BTEX) and polynuclear aromatic hydrocarbons (PAHs). Toxicity values exist for these constituents. Where these constituents were detected, they were quantitatively evaluated.

## **10.4 RISK CHARACTERIZATION**

In this section, potential impacts to human health from industrial and residential exposures to COPCs are characterized for each NWS Concord Inland Area site. Section 10.4.1 presents the methods used to estimate carcinogenic risks and noncarcinogenic hazards associated with exposure to COPCs in soil, sediment, and groundwater at the Inland Area sites, as well as health effects from exposure to lead. Section 10.4.2 presents the risk and hazard estimates for each of the Inland Area sites. In Section 10.4.3, COPC concentrations are compared to soil screening levels. Uncertainties associated with the risk assessment are discussed in Section 10.4.4.

### **10.4.1 Risk Characterization Methodology**

For the NWS Concord Inland Area sites, carcinogenic risks and noncarcinogenic hazards are estimated by comparing site concentrations of each COPC to EPA Region IX industrial and residential PRGs (1996b).

#### **10.4.1.1 Carcinogenic Risks**

PRGs are typically used as a screening tool to assess the potential threat to human health associated with exposure to a single contaminant in a particular environmental medium. For COPCs that are classified as carcinogens, cancer risk associated with exposure to a single contaminant is estimated by comparing the exposure point concentration of the carcinogen (95 UCL) to the cancer PRG using the following equation:

$$\text{Cancer risk} = (\text{EPC}/\text{PRG}) \times 10^{-6}$$

where:

EPC	=	Exposure point concentration (mg/kg)
PRG	=	Region IX Preliminary Remediation Goal (mg/kg)

At a given site, individuals may be exposed to more than one substance. The carcinogenic risks associated with exposure to multiple contaminants can be assessed using an approach outlined by EPA

in its memorandum regarding the derivation of PRGs (EPA 1996b). The total risk from exposure to multiple contaminants is calculated using the following equation:

$$\text{Total risk} = 10^{-6} \times \{EPC_1/PRG_1 + EPC_2/PRG_2 + \dots + EPC_n/PRG_n\}$$

where:

Total risk	=	total carcinogenic risk from exposure to all contaminants (unitless)
$EPC_n$	=	exposure point concentration of contaminant n (mg/kg)
$PRG_n$	=	PRG for contaminant n (mg/kg)

Cancer risk is expressed as a probability. For example,  $10^{-6}$  translates to an individual excess cancer risk of 1 in 1 million. The National Oil and Hazardous Substances Pollution Contingency Plan indicates “that for known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual between  $10^{-4}$  and  $10^{-6}$ ” (EPA 1990a). Risks that fall within this range are said to be within the acceptable risk range, and risks below  $1 \times 10^{-6}$  are considered insignificant. Risks above  $10^{-4}$  exceed the acceptable risk range and may indicate the need for further evaluation or remediation. For the purposes of this assessment, the range between  $1 \times 10^{-4}$  and  $1 \times 10^{-6}$  is referred to as the target risk range.

#### 10.4.1.2 Noncarcinogenic Hazards

For COPCs that are not classified as carcinogens and for those carcinogens known to cause adverse health effects other than cancer, the potential for individuals to develop adverse health effects is evaluated by comparing exposure point concentrations (95 UCL) to noncancer PRGs. When calculated for a single chemical, this comparison estimates a hazard quotient and is expressed in the following equation:

$$\text{Hazard quotient} = EPC/PRG$$

where:

PRG	=	Region IX Preliminary Remediation Goal (mg/kg)
EPC	=	Exposure point concentration (mg/kg)

To evaluate the potential for noncarcinogenic effects from exposure to multiple chemicals, the hazard quotients for all chemicals are summed, yielding a hazard index as follows:

$$\text{Hazard index} = EPC_1/PRG_1 + EPC_2/PRG_2 + \dots + EPC_n/PRG_n$$

where:

$EPC_n$	=	exposure point concentration of contaminant n (mg/kg)
$PRG_n$	=	PRG for contaminant n (mg/kg)

When the total hazard index exceeds 1, further evaluation in the form of a segregation of hazard index analysis is typically performed to determine whether noncarcinogenic hazards are a concern at the site. This is because the noncarcinogenic effects of chemicals with different target organs are generally not additive. If any one segregated hazard index exceeds 1, it indicates the potential for adverse noncarcinogenic health effects to occur (EPA 1989d). A segregated hazard index of less than 1 indicates little or no potential for adverse noncarcinogenic health effects.

#### **10.4.1.3 Lead Evaluation**

The PRG for lead does not represent a soil concentration corresponding to a hazard quotient of 1. Instead, the Cal-modified residential soil PRG for lead was calculated using the Cal/EPA blood-lead model, which is used to estimate blood-lead concentrations that may result from exposures to both site-related and nonsite-related lead sources. Based on the model, a blood-lead concentration at which adverse health effects have not been observed corresponds to a lead soil concentration of 130 mg/kg for a child resident. The EPA Region IX residential and industrial soil PRGs for lead are 400 mg/kg and 1,000 mg/kg, respectively. The tap water PRG for lead is 4 micrograms per liter ( $\mu\text{g/L}$ ). Because lead is not evaluated by calculating a hazard quotient, lead is excluded from the tables in Appendix N. For the purposes of this assessment, lead is evaluated separately by comparing site concentrations to the lead PRGs.

#### **10.4.2 Risk and Hazard Estimates**

Cancer risks and hazards associated with industrial and future hypothetical residential land-use conditions for each of the Inland Area sites are summarized in the following section. Chemical-specific and total cancer risks and hazards for each land use scenario, soil depth, and environmental medium are presented in Appendix N. Both RME and maximum cancer risks and hazard indices were calculated; however, only the risk characterization results of the RME case are discussed unless otherwise stated.

Chemicals of concern (COC) are identified for each site. COCs are defined as constituents with a cancer risk greater than  $1 \times 10^{-6}$  or an HQ greater than 1.

##### **10.4.2.1 Site 13 - Burn Area**

The objective of the HHRA conducted at Site 13 (the Burn Area) was to evaluate the potential carcinogenic risks and noncarcinogenic hazards associated with COPCs in surface soil (0 to 0.5 feet bgs), subsurface soil (0 to 10 feet bgs), and groundwater at the site and to identify COCs.

The risk characterization results for Site 13 are summarized in Tables 10-1 (industrial scenario) and 10-2 (residential scenario). Tables N-1 through N-5 in Appendix N present the chemical-specific and total risks and hazards associated with industrial and residential exposure to all COPCs identified at the site.

**Soil - Industrial Scenario:** The RME carcinogenic risk for an industrial worker exposed to COPCs identified in surface soil ( $6.7 \times 10^{-7}$ ) at Site 13 is less than the target risk range, while the risk for exposure to COPCs in subsurface soil ( $1.5 \times 10^{-6}$ ) is within the target risk range. No carcinogenic COCs were identified for industrial land use at Site 13.

The total hazard indices for industrial exposure to COPCs in surface and subsurface soil are less than 1.0, indicating no potential for adverse noncarcinogenic health effects for an individual working in the vicinity of the Site 13 Burn Area.

**Soil - Residential Scenario:** The RME carcinogenic risks for a resident exposed to COPCs in surface soil ( $3.6 \times 10^{-6}$ ) and subsurface soil ( $7.3 \times 10^{-6}$ ) are within the target risk range. The risks for both soil depth intervals can be attributed primarily to beryllium. The beryllium detected in soil does not appear to be site related; no source was identified. The risk for exposure to COPCs in subsurface soil can also be attributed to benzo(a)pyrene. Benzo(a)pyrene was only detected in 2 of 125 samples at concentrations (0.07 and 0.3 mg/kg) that are comparable to ambient levels in urban and rural soils (ATSDR 1995).

The total hazard indices for residential exposure to COPCs in surface soil and subsurface soil are less than 1.0.

**Groundwater - Residential Scenario:** No carcinogenic COPCs were detected in groundwater samples collected at Site 13. The RME hazard index for a resident exposed to Site 13 groundwater is 3.4. This hazard index, which exceeds the threshold value of 1, is attributable to manganese (1.8). The RME concentration for manganese is equal to the maximum concentration detected in groundwater and was collected from monitoring well MW10 (3.1 mg/L). All other manganese concentrations were below the manganese residential tap water PRG of 1.7 mg/L.

**Total - Residential Scenario:** Residents who live in the vicinity of Site 13 may be exposed simultaneously to COPCs present in soil and groundwater. Because no carcinogenic COPCs were identified in groundwater, the total RME carcinogenic risk attributable to all media evaluated at the site is equal to the risks associated with surface soil ( $3.6 \times 10^{-6}$ ) or subsurface soil ( $7.3 \times 10^{-6}$ ) alone. The total RME hazard index associated with simultaneous exposure to surface soil and groundwater is 4.1.



Because the hazard index for subsurface soil and surface soil are the same, the total hazard index for subsurface soil and groundwater is also 4.1. In both cases, the hazard index is attributable to the maximum concentration of manganese detected in groundwater.

**Lead Evaluation:** The RME lead concentrations in surface soil (106 mg/kg) and subsurface soil (33 mg/kg) are below the Cal-modified residential PRG (130 mg/kg) and the EPA Region IX industrial PRG of 1,000 mg/kg. Analytical results from the RI for Site 13, however, showed lead present in two trench locations at concentrations of 5,590 and 3,090 mg/kg. Based on these results, confirmation samples were collected in February 1996 in an effort to confirm the presence and assess the extent of the previously detected lead. The confirmation samples showed lead at concentrations much lower than those reported in the RI samples. The lead concentrations ranged from 4.9 to 235 mg/kg. In groundwater, lead was detected at a maximum concentration of 1.3 µg/L, which is below the tap water PRG for lead of 4 µg/L.

#### **10.4.2.2 Site 17 - Building IA-24**

The objective of the HHRA conducted at Site 17 (Building IA-24) was to evaluate the potential carcinogenic risks and noncarcinogenic hazards associated with COPCs in surface soil (0 to 0.5 feet bgs), subsurface soil (0 to 10 feet bgs), sediment, and groundwater at the site and to identify COCs. The risk characterization results for Site 17 are summarized in Tables 10-3 (industrial scenario) and 10-4 (residential scenario). Tables N-6 through N-11 in Appendix N present the chemical-specific and total risks and hazards associated with industrial and residential exposure to all COPCs identified at the site.

**Soil - Industrial Scenario:** The RME carcinogenic risks for an industrial worker exposed to COPCs in surface soil ( $1.4 \times 10^{-6}$ ) and subsurface soil ( $1.8 \times 10^{-6}$ ) are within the target risk range. The hazard indices for industrial exposure to COPCs in surface soil and subsurface soil are less than 1. No carcinogenic or noncarcinogenic COCs were identified for the industrial scenario.

**Soil - Residential Scenario:** The RME carcinogenic risks for a resident exposed to surface soil ( $6.7 \times 10^{-6}$ ) and subsurface soil ( $1.0 \times 10^{-5}$ ) are within the target risk range. For both soil depth intervals evaluated, the risks at the site can be attributed to beryllium and benzo(a)pyrene. The beryllium detected in soil does not appear to be site related; no source was identified and site concentrations are comparable to ambient levels. The risk associated with residential exposure to ambient levels of beryllium is  $2.2 \times 10^{-6}$  (Table 10-14). The risk associated with benzo(a)pyrene was based on the maximum concentration (0.1 mg/kg), which is comparable to ambient levels in urban and rural soils (ATSDR 1995). Benzo(a)pyrene was detected in three of the seven surface soil samples

collected at Site 17, and was not detected in the seven samples collected from 0.5 to 10 feet bgs.

The RME hazard indices associated with residential exposure to COPCs in surface soil (0.79) and subsurface soil (0.73) are both less than the threshold level of 1.

**Sediment - Residential Scenario:** The RME carcinogenic risk associated with residential exposure to COPCs in sediment is  $1.8 \times 10^{-5}$ . This risk, which is within the target range, is attributable to the COCs arsenic ( $1.5 \times 10^{-5}$ ) and beryllium ( $2.8 \times 10^{-6}$ ). The maximum concentrations of arsenic (5.7 mg/kg) and beryllium (0.4 mg/kg) in sediments are both less than the ambient levels for arsenic (7.3 mg/kg) and beryllium (0.56 mg/kg) in soil. The RME hazard index (0.77) for residential exposure to sediment is below the threshold value of 1.

**Groundwater - Residential Scenario:** The RME carcinogenic risk associated with residential exposure to COPCs in groundwater is  $5.6 \times 10^{-6}$ . The only groundwater COC identified at Site 17 is bis(2-ethylhexyl)phthalate ( $5.6 \times 10^{-6}$ ). The hazard index is 0.22, which is below the threshold value of 1.

The results of the HHRA for residential exposure to COPCs in groundwater at Site 17 were based on data collected from monitoring wells only. Groundwater samples collected at Site 17 include 1 SI sample and 10 RI samples (two events from five monitoring wells). The SI sample was from a grab sample collected from a temporary well. Since this sample was not filtered and likely represents both the dissolved and particulate metals, it does not reflect true groundwater metal concentrations and is not used in the HHRA.

**Total - Residential Scenario:** Residents who live in the vicinity of Building IA-24 may be exposed simultaneously to COPCs present in soil and groundwater. Because it is unlikely that an individual would be exposed to COPCs in soil and sediment simultaneously for the entire exposure period evaluated, the total RME risks and hazards do not include exposures to sediment. The total RME carcinogenic risk associated with exposure to surface soil and groundwater is  $1.2 \times 10^{-5}$ . For subsurface soil and groundwater, the total risk is  $1.6 \times 10^{-5}$ . In both cases, the risk is attributable to beryllium and benzo(a)pyrene detected in soil and bis(2-ethylhexyl)phthalate detected in groundwater. The total RME hazard index associated with simultaneous exposure to surface soil and groundwater is equal to the threshold value of 1. For subsurface soil and groundwater, the total hazard index is 0.95.

**Lead Evaluation:** The RME lead concentrations in surface soil (225 mg/kg) and subsurface soil (24 mg/kg) are significantly below the industrial PRG of 1,000 mg/kg. The RME lead concentration in

surface soil, which is equal to the maximum lead concentration detected at the site, is slightly above the Cal-modified PRG of 130 mg/kg. Only 3 of 46 samples contained lead at concentrations above 130 mg/kg. The mean lead concentration in surface soil was 65.4 mg/kg. The RME lead concentration in sediment (14 mg/kg) is less than the residential PRG for soil of 130 mg/kg. Lead was not detected in groundwater samples collected from monitoring wells at Site 17.

#### **10.4.2.3 Site 22 - Building 7SH5**

The objective of the HHRA conducted at Site 22 (Building 7SH5) was to evaluate the potential carcinogenic risks and noncarcinogenic hazards associated with COPCs in surface soil (0 to 0.5 feet bgs), subsurface soil (0 to 10 feet bgs), and groundwater at the site and to identify COCs. The risk characterization results for Site 22 are summarized in Tables 10-5 (industrial scenario) and 10-6 (residential scenario). Tables N-12 through N-16 in Appendix N present the chemical-specific and total risks and hazards associated with industrial and residential exposure to all COPCs identified at the site.

**Soil - Industrial Scenario:** The RME carcinogenic risk for an industrial worker exposed to COPCs in surface soil ( $3.5 \times 10^{-5}$ ) and subsurface soil ( $1.6 \times 10^{-5}$ ) are within the target risk range. Arsenic is the only industrial COC identified for soil at Site 22. Arsenic was detected in all eight surface soil samples at concentrations greater than the ambient levels established for Site 22 soils (15 mg/kg). The presence of elevated arsenic in surface soil samples is not consistent with known past activities. Section 7.5 of this report presents information on the historical operations at Site 22.

The RME hazard indices associated with industrial exposure to surface soil (0.23) and subsurface soil (0.11) are less than the threshold value of 1.

**Soil - Residential Scenario:** The RME carcinogenic risk associated with residential exposure to COPCs in surface soil ( $2.2 \times 10^{-4}$ ) slightly exceeds the target risk range, and the risk for exposure to subsurface soil ( $1 \times 10^{-4}$ ) is at the upper limit of the target risk range. For both depth intervals, the risks can be attributed to arsenic and beryllium. As discussed for the industrial scenario, arsenic was detected in all eight surface soil samples at concentrations greater than the ambient levels established for Site 22 soils (15 mg/kg). The RME hazard indices for surface soil (4.3) and subsurface soil (2.2) exceed the threshold value of 1 and can also be attributed to the presence of arsenic at the site.

**Groundwater - Residential Scenario:** The RME carcinogenic risk associated with residential exposure to COPCs in groundwater is  $1.6 \times 10^{-5}$ . This risk, which is within the target risk range, can be attributed entirely to a single detection of trichloroethene. A temporary well was used to collect

three grab groundwater samples at Site 22. Trichloroethene was detected in one sample at a concentration of 0.027 mg/L. Because of the uncertainty associated with grab groundwater samples, these results are not necessarily representative of actual groundwater conditions at Site 22. Four monitoring wells have been installed, and analytical results from these wells are necessary to confirm the presence of this COC. The phase II groundwater RI will present the results of this sampling effort.

The RME hazard index for groundwater (0.74) is below the threshold value of 1.

**Total - Residential Scenario:** Residents who live in the vicinity of Building 7SH5 may be exposed simultaneously to COPCs present in soil and groundwater. The total RME carcinogenic risk associated with exposure to surface soil and groundwater is  $2.4 \times 10^{-4}$ . For subsurface soil and groundwater, the total risk is  $1.2 \times 10^{-4}$ . In both cases, the risk is attributable to arsenic and beryllium detected in soil and trichloroethene detected in groundwater. The total RME hazard index associated with simultaneous exposure to surface soil and groundwater is 5. For subsurface soil and groundwater, the hazard index is 3.

**Lead Evaluation:** The RME lead concentrations in surface soil (156 mg/kg) and subsurface soil (29 mg/kg) are significantly below the industrial PRGs of 1,000 mg/kg; however, the RME lead concentration in surface soil is slightly above the Cal-modified residential PRG of 130 mg/kg. Only one sample of lead (of 30 samples analyzed for lead) contained a lead concentration (165 mg/kg) above 130 mg/kg. Analyses for lead were not performed for groundwater samples collected from monitoring wells at Site 17.

#### 10.4.2.4 Site 24A - Pistol Firing Range

The objective of the HHRA conducted at Site 24A (the Pistol Firing Range) was to evaluate the potential carcinogenic risks and noncarcinogenic hazards associated with COPCs in surface soil (0 to 0.5 feet bgs) and subsurface soil (0 to 10 feet bgs) at the site and to identify COCs. The risk characterization results for Site 24A are summarized in Tables 10-7 (industrial scenario) and 10-8 (residential scenario). Tables N-17 through N-20 in Appendix N present the chemical-specific and total risks and hazards associated with industrial and residential exposure to all COPCs identified at the site.

**Soil - Industrial Scenario:** The RME carcinogenic risks for an industrial worker exposed to surface soil ( $3.4 \times 10^{-6}$ ) and subsurface soil ( $7.2 \times 10^{-5}$ ) are within the target risk range. For both depth intervals evaluated, the risks can be attributed to arsenic. The RME concentrations of arsenic in surface soil and subsurface soil are below the ambient level for arsenic (7.3 mg/kg). The risk associated with industrial exposure to ambient levels of arsenic is  $1.8 \times 10^{-6}$  (Table 10-13). For

subsurface soil at Site 24A, PAHs were also identified as COCs. The risks associated with benzo(a)pyrene ( $3.8 \times 10^{-5}$ ) and other PAHs ( $3.1 \times 10^{-5}$ ) are based on the maximum concentrations of these chemicals. The RME hazard indices associated with industrial exposure to COPCs in surface and subsurface soil are below the threshold value of 1.0.

**Soil - Residential Scenario:** The RME carcinogenic risk associated with residential exposure to COPCs in surface soil ( $2 \times 10^{-5}$ ) is within the target risk range, and the risk for exposure to subsurface soil ( $3.2 \times 10^{-4}$ ) slightly exceeds the target risk range. For both depth intervals evaluated, the risks can be attributed to arsenic and beryllium. The RME concentrations of arsenic and beryllium in surface soil and subsurface soil are below the ambient level for arsenic (7.3 mg/kg) and beryllium (0.56 mg/kg). The risks associated with residential exposure to ambient levels of arsenic and beryllium are  $1.2 \times 10^{-5}$  and  $2.2 \times 10^{-6}$ , respectively (Table 10-14). For subsurface soil at Site 24A, PAHs were also identified as COCs. The risks associated with benzo(a)pyrene ( $1.6 \times 10^{-4}$ ) and other PAHs ( $1.3 \times 10^{-4}$ ) are based on the maximum concentrations of these chemicals. The RME hazard indices associated with residential exposure to COPCs in surface soil (1.5) and subsurface soil (1.7) exceed the threshold value of 1.0; however, no chemical-specific hazard quotient exceeds 1.

**Lead Evaluation:** The maximum concentration of lead detected at the site (7,110 mg/kg) was used to evaluate the health effects associated with lead. Five samples in the vicinity of the firing berm and adjacent drainage ditch contain lead concentrations greater than the industrial PRG of 1,000 mg/kg and eight samples in this area exceed the Cal-modified residential PRG of 130 mg/kg. Lead concentrations diminish significantly with distance from the target berm.

#### 10.4.2.5 Site 27 - Building IA-20

The objective of the HHRA conducted at Site 27 (Building IA-20) was to evaluate the potential carcinogenic risks and noncarcinogenic hazards associated with COPCs in surface soil (0 to 0.5 feet bgs) and subsurface soil (0 to 10 feet bgs) at the site and to identify COCs. The risk characterization results for Site 27 are summarized in Tables 10-9 (industrial scenario) and 10-10 (residential scenario). Tables N-21 through N-24 in Appendix N present the chemical-specific and total risks and hazards associated with industrial and residential exposure to all COPCs identified at the site.

**Soil - Industrial Scenario:** The RME carcinogenic risks for an industrial worker exposed to COPCs in surface soil ( $3.5 \times 10^{-5}$ ) and subsurface soil ( $2.7 \times 10^{-5}$ ) are within the target risk range. Alpha-chlordane and gamma-chlordane are the only industrial COCs identified for Site 27. The risks for surface soil were based on the maximum concentrations of these COCs. For purposes of

comparison, an evaluation of the risks associated with industrial exposure to the average concentration of alpha-chlordane (3 mg/kg) indicates that the risk is at the lower end of the target risk range ( $2.0 \times 10^{-6}$ ). The risk for the average concentration of gamma-chlordane (4 mg/kg) was  $2.7 \times 10^{-6}$ . Alpha and gamma-chlordane concentrations exceeded the industrial PRG (1.5 mg/kg) in 3 samples collected around the building foundations. The RME hazard index for surface soil (1.2) slightly exceeds the threshold value of 1.0, while the subsurface soil hazard index (0.95) is below the threshold value of 1.0.

**Soil - Residential Scenario:** The RME carcinogenic risks for residential exposure to COPCs in surface soil ( $1.5 \times 10^{-4}$ ) and subsurface soil ( $1.2 \times 10^{-4}$ ) are at the upper end of the target risk range. The residential COCs identified for surface soil and subsurface soil at Site 27 are alpha-chlordane, gamma-chlordane, Aroclor-1248, Aroclor-1254, and dieldrin. The risks for alpha-chlordane and gamma-chlordane detected in surface soil were based on the maximum concentrations of these COCs. For purposes of comparison, an evaluation of the risks associated with residential exposure to the average concentration of alpha-chlordane (3 mg/kg) indicates that the risk is well within the target risk range ( $8.8 \times 10^{-6}$ ). The risk for the average concentration of gamma-chlordane (4 mg/kg) was  $1.2 \times 10^{-5}$ . The risks for Aroclor-1248 ( $2 \times 10^{-6}$ ), Aroclor-1254 ( $3.9 \times 10^{-6}$ ), and dieldrin ( $2.6 \times 10^{-6}$ ) were also based on the maximum concentrations of these COCs. For dieldrin, the maximum concentration (0.07 mg/kg) was the only concentration to exceed the residential PRG of 0.03 mg/kg. 4,4'-Dichlorodiphenyldichloroethane (4,4'-DDD) was also identified as a COC for surface soil only. The risk for 4,4'-DDD was based on the maximum concentration (8 mg/kg) which was the only concentration to exceed the residential PRG of 1.9 mg/kg. The RME hazard indices for surface soil (13) and subsurface soil (10) exceed the threshold value of 1 and can also be attributed to the maximum concentration of alpha- and gamma-chlordane. The hazard quotients for residential exposure to the average concentrations of alpha-chlordane (0.77) and gamma-chlordane (1) are less than or equal to the threshold value of 1.

#### **10.4.3 Soil Screening Level Comparison**

At the request of EPA, concentrations of COPCs detected in soil at each Inland Area site were compared to EPA's generic soil screening levels (SSL). The methodology for calculating SSLs considers fate and transport mechanisms to identify chemical concentrations in soil that have the potential to contaminate groundwater. Generic SSLs are risk-based concentrations derived using default values in standardized equations presented in EPA's soil screening guidance (EPA 1996d). These conservative (health-protective) default assumptions are designed to address human exposure pathways in a residential setting under RME conditions. SSLs are generally based on a  $1 \times 10^{-6}$  risk for

carcinogens or a hazard quotient of 1 for noncarcinogens and are backcalculated from acceptable groundwater concentrations (that is, non-zero maximum contaminant level goals (MCLG), maximum contaminant levels (MCL), or risk-based PRGs). SSLs provide a framework for screening contaminants in site soils. Generally, if an SSL is not exceeded, the migration to groundwater pathway may be eliminated from further consideration. A site concentration that exceeds the SSLs does not alone trigger the need for response actions or define “unacceptable” levels of contaminants in soil (EPA 1996d). When site concentrations exceed the SSLs, further evaluation, but not necessarily cleanup, may be warranted.

SSLs are presented in the EPA soil screening guidance (Table A-1) for two contaminant transport conditions: (1) SSLs developed using a default dilution-attenuation factor (DAF) of 20 to account for natural processes that reduce contaminant concentrations in the subsurface, and (2) SSLs developed using a DAF of 1 assuming no dilution or attenuation between the source and the receptor well. For purposes of the SSL comparison performed for the NWS Concord Inland Area sites, site concentrations were compared to generic SSLs developed using a DAF of 20. A DAF of 20 was used at the NWS Concord Inland Area site because the groundwater is greater than 30 feet bgs. It is assumed that transportation of chemicals more than 30 feet vertically through soil would result in reduction of contaminant concentrations before reaching groundwater. Table 10-15 presents the COPCs that exceed the SSLs for each of the Inland Area sites. The results of the comparison of site RME concentrations to SSLs at each site are summarized below.

**Site 13:** 2,4-Dinitrotoluene is the only COPC to exceed its SSL at Site 13. 2,4-Dinitrotoluene was only detected in 1 out of 131 samples collected at Site 13 and was not detected in site groundwater.

**Site 17:** No COPC at Site 17 exceeded its respective SSL.

**Site 22:** Arsenic is the only COPC to exceed an SSL at Site 22. The RME concentration of arsenic in soil at Site 22 is 32 mg/kg, which is only slightly above the SSL for arsenic (29 mg/kg).

**Site 24A:** Metals (antimony and lead), carcinogenic PAHs (benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, and dibenz[a,h]anthracene) and carbazole concentrations exceed their SSLs at Site 24A. The PAHs and carbazole exceeded their SSLs in only one sample from the firing berm (0.5 to 1.5 feet bgs). Groundwater was not analyzed at the site because of the low vertical mobility of metals in soil demonstrated during the SI and confirmed by the RI results. As seen in Table 12-5, the PAHs have low mobility, so they may persist in soil but are not expected to impact groundwater. As seen in Table 8-3, the concentrations of carbazole decrease by more than an order of magnitude between the surface soil sample (0.0 to 1.5 feet bgs) and the subsurface sample (7.2 to 7.5 feet bgs).

The subsurface concentration of carbazole (0.66 mg/kg) is only slightly higher than the SSL (0.6 mg/kg). Carbazole is not expected to impact groundwater because its concentration decreased to levels close to the SSL at seven vertical feet of soil. Groundwater is estimated to be tens to hundreds of feet below ground surface at Site 24A.

**Site 27:** Pentachlorophenol (PCP), alpha-chlordane, gamma-chlordane, and dieldrin are the only COPCs to exceed their SSL at Site 27. Pentachlorophenol was detected in 1 out of 19 samples, while dieldrin was detected in 4 of 31 samples collected from 0 feet to the maximum depth sampled in soil at Site 27. As shown in Table 12-5, chlordane and dieldrin have low mobilities and tend to sorb to soil. Neither chemical was detected in subsurface soil samples. For these reasons these chemicals are not expected to impact groundwater. PCP was detected in only 1 surface soil sample collected at Site 27 and no source of PCP has been identified. Consequently, PCP is not expected to impact groundwater.

#### **10.4.4 Uncertainty Associated with the Risk Assessment**

A number of uncertainties are inherent in the estimates of potential carcinogenic risk and noncarcinogenic hazard presented in this document. These uncertainties were generally associated with either (1) the sampling strategy and site characterization process or (2) the assumptions and extrapolations that comprise the risk assessment process. Possible uncertainties of both types are described below.

##### **10.4.4.1 Data Evaluation and Identification of Chemicals of Potential Concern**

To identify COPCs for the human health risk assessment, the adequacy of site characterization data was reviewed, and a structured selection process was employed.

#### Site Characterization Data

The risk assessment is based on analytical data from the SI, the SWMU investigations, the RI, and the Site 13 confirmation sampling. Although the total number of samples collected during these investigations was quite large, not all samples were analyzed for the full suite of compounds. In accordance with the approved field sampling and analysis plan (PRC/Montgomery Watson 1995b), if the site history did not suggest chemicals of a particular class were likely to have been used or released at a site, the number of samples analyzed for that class of compounds was limited. For example, the objective of the investigation performed at Site 24A was to evaluate the nature and extent of metals detected in the firing range target berms and drainage areas that are the result of past and present



activities at the site. Consequently, limited SVOC analyses were performed at Site 24A and these analyses were performed only because an organic odor was noticed during surface soil sample collection. This sampling strategy is consistent with EPA guidance that describes the objective of the RI as characterization of the nature and extent of contaminants identified through the preliminary assessment and site investigation (PA/SI) process (EPA 1988). The limited sampling for nonsite-related compounds at a few sites led to detection of one such compound in a single sample from a site. In these cases, data interpretation is contingent on assumptions related to the distribution of that contaminant, and with the uncertainties inherent in these assumptions, actual risk may have been under- or overestimated.

Because there was no reason to expect that the nonsite-related contaminants would be present, these single detections were generally interpreted as isolated incidents during the RI characterization. This assumption is bolstered by the fact that the sampling approach employed for the RI was "purposive" (soil samples were collected from locations believed to be the most highly contaminated based on site history, then additional sampling locations were added to establish the extent of the problem). This technique increases the likelihood that all site-related contaminants are characterized for each site. Yet, it requires the additional assumption that knowledge of the site has been adequate to facilitate identification of all potentially contaminated locations and contaminants.

In the risk assessment, these detections of nonsite-related compounds were found to constitute the primary risk drivers at several sites. If it is assumed that some of these detections represent isolated incidences, the actual risk associated with exposure at the site may have been overestimated.

### Selection Process

The primary uncertainty associated with the COPC selection process is the possibility that a chemical may be inappropriately identified as a COPC for evaluation in the risk assessment (that is, a detected chemical may be inappropriately excluded or included as a COPC). For the NWS Concord Inland Area sites, the only analytes that were excluded from designation as COPCs were metals detected at concentrations below ambient levels and essential nutrients. For this reason, it is unlikely that any chemicals were inappropriately excluded from the risk assessment. Issues related to selection of inorganic and organic COPCs are described in the following text.

As part of the site-specific COPC-selection process, metal concentrations in soil samples collected from each of the sites (except Site 27, where metals were not investigated) were compared to two sets of ambient levels established for the Inland Area Sites. For Site 13 and 22, where more than 20 samples were collected, ambient levels were computed as the 95<sup>th</sup> percentile of the ambient data set. If less than

5 percent of the site samples contained the metal at concentrations greater than the ambient level, the metal was excluded from the list of COPCs. As a result of the limited number of ambient samples collected at Sites 17 and 24A, the ambient levels were equal to the maximum detected concentration of each metal in the ambient data set. A metal was eliminated from the risk assessment if a site concentration of the metal was less than the ambient level established for Sites 17 and 24A.

Both sets of ambient levels were estimated using soil samples collected from locations considered to be unaffected by Navy operations or other industrial activities. These ambient locations were topographically upgradient from each site and were determined using a stratified random sampling approach (Appendix A). A review of the metals concentrations detected in these ambient soil samples indicated that a few metals concentrations were either significantly higher or lower than the main population in the data set. Although anomalously high concentrations may represent the upper limit of the true ambient range for a site, these concentrations were removed from the ambient data set to reduce their impact on the estimates of ambient levels. A number of outliers, defined as concentrations that were greater than 3 times the standard deviation from the mean, were eliminated from the ambient data set for Sites 13 and 22. Arsenic concentrations at Site 22 exhibited the greatest variation. The extreme values of arsenic, ranging from 72 mg/kg to 250 mg/kg, were eliminated from the data set. A single concentration of manganese (5,150 mg/kg) detected in an ambient sample collected at Site 13 was also eliminated from the ambient data set. In both of these cases, the concentration of the outlier exceeds the residential PRG. For arsenic, a number of concentrations detected at the site are comparable to the range of outlier values, indicating that these values may represent the upper range of ambient for the metal; however, the value eliminated for manganese was greater than all the site concentrations detected at each site for this metal. Although elimination of this value from the ambient data set may lower the ambient level established for manganese at Site 13, the actual risks may have been underestimated because this manganese value was also eliminated from the data set used to assess risk at Site 13.

#### **10.4.4.2 Exposure Assessment**

Uncertainties were identified in association with two areas of the exposure assessment process: (1) identification of receptors and (2) the derivation of exposure point concentrations. Uncertainties in each of these areas are discussed in the following text.

##### **Identification of Receptors**

Receptors and exposure scenarios are identified based on observed and assumed land use and activity patterns of the current and future receptors. To the degree that actual land use and activity patterns are

not represented by those assumed, uncertainties are introduced. For example, future land use is assumed to be residential for all sites; however, future land use is not expected to change from its current use as an open naval base.

#### Derivation of Exposure Point Concentrations

As discussed in Section 10.2.3, it was determined that use of the upper 95 percent confidence limit on the arithmetic mean (95 UCL) as the exposure point concentration for each COPC was a reasonable approach for the Inland Area sites, given that the large number of samples collected at each site adequately characterized the nature and extent of chemical contamination. The use of 95 UCL concentrations is recommended by EPA for evaluating RME conditions. For small data sets, the 95 UCL often exceeded the maximum detected concentration at a site because the standard deviation associated with small data sets is high. Consequently, the maximum detected concentration (or the concentration of a single detected value) was often used as the RME concentration. The exposure point concentrations based on the maximum concentration are likely to overestimate the concentrations and associated risks at each site.

For most metals detected at a site, the data set was sufficiently large to calculate a 95 UCL, and the maximum concentration was rarely used as the RME concentration. For this reason, although the RME concentrations for these metals are less than residential PRGs, it is possible that metals were detected at concentrations exceeding their residential PRGs. Metals concentrations that exceed residential PRGs are discussed below.

For Site 13, a single concentration of aluminum and antimony and two concentrations of barium and cadmium were detected in the 0 to 10-foot depth interval at concentrations exceeding their respective residential soil PRGs. Lead concentrations exceeded the Cal-modified PRG in nine samples. All beryllium concentrations detected at Site 13 were greater than the residential PRG for the metal. The RME site concentrations for these metals are all less than residential PRGs. The distribution of these COPCs and how they relate to site history are discussed in Section 5.5.

For Site 17, a single concentration of nickel was detected in the 0 to 10-foot depth interval at a concentration exceeding its residential soil PRGs. Lead concentrations exceeded the Cal-modified PRG in three samples. All beryllium concentrations detected at Site 17 were greater than the residential PRG for the metal. The RME site concentrations for these metals are all less than residential PRGs. The distribution of these COPCs and how they relate to site history are discussed in Section 6.5.

For Site 22, all arsenic and beryllium concentrations detected in the 0 to 10-foot depth interval exceeded their respective residential soil PRGs. Lead concentrations exceeded the Cal-modified residential PRG in a single sample. The distribution of these COPCs and how they relate to site history are discussed in Section 7.5.

For Site 24A, single concentrations of antimony and cadmium were detected in the 0 to 10-foot depth interval at concentrations exceeding their respective residential soil PRGs. Lead concentrations exceeded the Cal-modified PRG in eight samples. All arsenic and beryllium concentrations detected at Site 24A were greater than the residential PRG for these metal. The distribution of these COPCs and how they relate to site history are discussed in Section 8.5.

Analyses for metals were not performed for soil samples collected at Site 27 because historical information and analytical results from prior investigations indicated that no source for metals exists at the site.

#### **10.4.4.3 Toxicity Assessment**

The primary uncertainties associated with the toxicity assessment are related to derivation of toxicity values for COPCs. Standard toxicity values (RfDs and SFs) were used by EPA Region IX to derive the PRGs used in this HHRA. The uncertainties associated with the unavailability of toxicity values for all COPCs and the chemical-specific factors for chromium are described in the following text.

##### Unavailability of Toxicity Values

The carcinogenic risks and noncarcinogenic hazards can be assessed only for those COPCs for which the relevant toxicity values are available. For COPCs for which an SF or RfD was available for only one route of exposure, route-to-route extrapolations were made in the derivation of the Region IX PRGs. These extrapolations will introduce some uncertainty into the risk and hazard estimates.

##### Chromium Speciation

The selection of the appropriate toxicity value for chromium depends on the chemical species of chromium that is encountered; hexavalent chromium is a potent carcinogen by the inhalation route, whereas trivalent chromium is not a carcinogen. Chromium occurs primarily in the trivalent form in

nature. Trivalent chromium has a more stable oxidation state than hexavalent chromium. Hexavalent chromium is easily transformed to trivalent chromium in reducing environments, such as those found in acidic soils or soils that contain iron or dissolved sulfides. Further, iron and dissolved sulfides in soil will reduce hexavalent chromium to trivalent chromium (Fetter 1993).

Based on the history of activities at the NWS Concord Inland Area sites, hexavalent chromium was not expected to be detected. To confirm the absence of hexavalent chromium at these sites, approximately 9 to 21 percent of the samples analyzed for total chromium were also analyzed for hexavalent chromium. Results of these analyses showed hexavalent chromium was not detected at any site. Consequently, total chromium results were assumed to be indicative of trivalent chromium concentrations.

For all the sites where the number of analyses performed for hexavalent chromium did not equal the number performed for total chromium, some uncertainty may have been introduced into the estimates of risk. To confirm that this uncertainty is unlikely to have led to a significant underestimation of risk, total chromium concentrations for each site were compared to the EPA Region IX residential soil PRG for chromium. The PRG for total chromium (210 mg/kg) assumes that 1/6 of the total chromium is present in the form of hexavalent chromium. With the exception of a single concentration detected at Site 13, all concentrations of chromium detected at the Inland Area sites are below the PRG for total chromium (210 mg/kg). At Site 13, the maximum total chromium concentration was 546 mg/kg, which is significantly below the trivalent chromium PRG of 77,000 mg/kg. Nine percent (12 out of 164 samples) of the samples analyzed for metals at Site 13 included analyses for hexavalent chromium. Hexavalent chromium was not detected in any of these samples. Consequently, it was assumed that chromium concentrations detected at Site 13 are present in the form of trivalent chromium.

**TABLE 10-1**  
**SITE 13 - BURN AREA**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**INDUSTRIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Media	RME Risk Assessment Results	Chemicals of Concern (COC) for the RME Case <sup>a</sup>			Comments
		Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	
<b>Surface soil</b>	Cancer Risk	--	--	--	No industrial COCs identified at Site 13.
	Hazard Index	--	--	--	No industrial COCs identified at Site 13.
	Lead Evaluation	--	--	--	The RME lead concentration in surface soil (106 mg/kg) was less than the industrial PRG of 1,000 mg/kg.
<b>Subsurface soil</b>	Cancer Risk	--	--	--	No industrial COCs identified at Site 13.
	Hazard Index	--	--	--	No industrial COCs identified at Site 13.
	Lead Evaluation	--	--	--	The RME lead concentration in subsurface soil (33 mg/kg) was less than the industrial PRG of 1,000 mg/kg.

<sup>a</sup> The chemicals listed are those for which the carcinogenic risk exceeds 1E-06 or the hazard quotient exceeds 1.

<sup>b</sup> The units are in milligrams per kilogram.

-- Not applicable or not available

COC Chemicals of concern

Conc. Concentration

HQ Hazard Quotient

RME Reasonable maximum exposure

**TABLE 10-2**  
**SITE 13 - BURN AREA**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**RESIDENTIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Media	RME Risk Assessment Results	Chemicals of Concern (COC) for the RME Case <sup>a</sup>			Comments
		Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	
<b>Surface soil</b>	Cancer Risk	Beryllium (10/34)	0.41	2.9E-06	No source of beryllium was identified.
	Hazard Index	--	--	--	No noncarcinogenic COCs identified.
	Lead Evaluation	--	--	--	The RME lead concentration in surface soil (106 mg/kg) was less than the residential PRG of 130 mg/kg. However, lead concentrations (5,590 mg/kg and 3,090 mg/kg) significantly higher than the screening level were detected in localized areas (hot spots) and may warrant further evaluation.
<b>Subsurface soil</b>	Cancer Risk	Beryllium (72/164)	0.45	3.1E-06	No source of beryllium was identified.
		Benzo(a)pyrene (2/125)	0.19	3.1E-06	Benzo(a)pyrene was detected at 0.07 and 0.3 mg/kg, which are comparable to background levels in urban and rural soils (ATSDR 1995).
	Hazard Index	--	--	--	No noncarcinogenic COCs identified.
	Lead Evaluation	--	--	--	The RME lead concentration in subsurface soil (33 mg/kg) was less than the residential PRG of 130 mg/kg. However, lead concentrations (5,590 mg/kg and 3,090 mg/kg) significantly higher than the screening level were detected in localized areas (hot spots) and may warrant further evaluation.

TABLE 10-2 (Continued)  
 SITE 13 - BURN AREA  
 SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS  
 RESIDENTIAL SCENARIO  
 NWS CONCORD, INLAND AREA SITES

Chemicals of Concern (COC) for the RME Case <sup>a</sup>					
Media	RME Risk Assessment Results	Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	Comments
Groundwater	Cancer Risk	--	--	--	No carcinogenic constituents detected.
	Hazard Index	3.4	Manganese (10/17)	3.1	1.8
					The RME manganese concentration is equal to the maximum detection. All other manganese detections are below the tap water PRG of 1.7 mg/L.

<sup>a</sup> The chemicals listed are those for which the carcinogenic risk exceeds 1E-06 or the hazard quotient exceeds 1.

<sup>b</sup> The units are in milligrams per kilogram for soil and milligrams per liter for groundwater.

-- Not applicable or not available

COC Chemicals of concern

Conc. Concentration

HQ Hazard Quotient

RME Reasonable maximum exposure



**TABLE 10-3**  
**SITE 17 - BUILDING IA-24**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**INDUSTRIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Media	RME Risk Assessment Results	Chemicals of Concern (COC) for the RME Case <sup>a</sup>			Comments
		Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	
Surface soil	Cancer Risk	--	--	--	No industrial COCs identified.
	Hazard Index	--	--	--	No industrial COCs identified.
	Lead Evaluation	--	--	--	The RME lead concentration in surface soil (225 mg/kg) was less than the industrial PRG of 1,000 mg/kg.
Subsurface soil	Cancer Risk	--	--	--	No industrial COCs identified.
	Hazard Index	--	--	--	No industrial COCs identified.
	Lead Evaluation	--	--	--	The RME lead concentration in subsurface soil (24 mg/kg) was significantly less than the industrial PRG of 1,000 mg/kg.

<sup>a</sup> The chemicals listed are those for which the carcinogenic risk exceeds 1E-06 or the hazard quotient exceeds 1.

<sup>b</sup> The units are in milligrams per kilogram.

-- Not applicable or not available

COC Chemicals of concern

Conc. Concentration

HQ Hazard Quotient

RME Reasonable maximum exposure

**TABLE 10-4**  
**SITE 17 - BUILDING IA-24**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**RESIDENTIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Media	RME Risk Assessment Results	Chemicals of Concern (COC) for the RME Case <sup>a</sup>			Comments
		Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	
Surface soil	Cancer Risk	Beryllium (14/15)	0.44	3.1E-06	No source of beryllium was identified. The risk associated with residential exposure to ambient levels of beryllium is 2.2E-06.
		Benzo(a)pyrene (3/7)	0.1	1.8E-06	The risk for benzo(a)pyrene is based on the maximum concentration (0.1 mg/kg), which is comparable to background levels in urban and rural soils (ATSDR 1995).
	Hazard Index	--	--	--	No noncarcinogenic COCs identified.
	Lead Evaluation	Lead (15/15)	225	--	The RME lead concentration is equal to the maximum concentration and is greater than the residential PRG of 130 mg/kg. The mean lead concentration is 65.4 mg/kg.
Subsurface soil	Cancer Risk	Beryllium (39/46)	0.95	6.7E-06	No source of beryllium was identified. The risk associated with residential exposure to ambient levels of beryllium is 2.2E-06.
		Benzo(a)pyrene (3/14)	0.1	1.8E-06	The risk for benzo(a)pyrene is based on the maximum concentration (0.1 mg/kg), which is comparable to background levels in urban and rural soils (ATSDR 1995).
	Hazard Index	--	--	--	No noncarcinogenic COCs identified.
	Lead Evaluation	--	--	--	The RME lead concentration (24 mg/kg) was less than the residential PRG of 130 mg/kg.

**TABLE 10-4 (Continued)**  
**SITE 17 - BUILDING 1A-24**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**RESIDENTIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Media	RME Risk Assessment Results	Chemicals of Concern (COC) for the RME Case <sup>a</sup>			Comments
		Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	
Sediment	Cancer Risk	Arsenic (4/4)	5.7	1.5E-05	The RME arsenic and beryllium concentrations in sediment are equal to their maximum concentrations and are less than the ambient level for arsenic in soil (7.3 mg/kg) and the ambient levels for beryllium in soil (0.56 mg/kg).
		Beryllium (4/4)	0.40	2.8E-06	
	Hazard Index	--	--	--	No noncarcinogenic COCs identified.
	Lead Evaluation	--	--	--	The RME lead concentration in sediment (14 mg/kg) is less than the residential PRG of 130 mg/kg.
Groundwater	Cancer Risk	Bis(2-ethylhexyl)phthalate (2/10)	0.027	5.6E-06	No noncarcinogenic COCs identified.
	Hazard Index	--	--	--	

<sup>a</sup> The chemicals listed are those for which the carcinogenic risk exceeds 1E-06 or the hazard quotient exceeds 1.

<sup>b</sup> The units are in milligrams per kilogram for soil and milligrams per liter for groundwater.

-- Not applicable or not available

COC Chemicals of concern

Conc. Concentration

HQ Hazard Quotient

RME Reasonable maximum exposure

**TABLE 10-5**  
**SITE 22 - BUILDING 7SH5**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**INDUSTRIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Chemicals of Concern (COC) for the RME Case <sup>a</sup>					
Media	RME Risk Assessment Results	Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	Comments
<b>Surface soil</b>	Cancer Risk	Arsenic (8/8)	82.4	3.5E-05	All eight arsenic concentrations exceed the ambient level for arsenic (15 mg/kg); however, no source of arsenic was identified. The risk associated with industrial exposure to ambient levels of arsenic is 3.0E-06.
	Hazard Index	--	--	--	No noncarcinogenic COCs identified.
	Lead Evaluation	--	--	--	The RME lead concentration in surface soil (156 mg/kg) was significantly less than the industrial PRG of 1,000 mg/kg.
<b>Subsurface soil</b>	Cancer Risk	Arsenic (31/31)	36.4	1.5E-05	The risk associated with industrial exposure to ambient levels of arsenic is 3.0E-06.
	Hazard Index	--	--	--	No noncarcinogenic COCs identified.
	Lead Evaluation	--	--	--	The RME lead concentration in subsurface soil (29 mg/kg) was significantly less than the industrial PRG of 1,000 mg/kg.

<sup>a</sup> The chemicals listed are those for which the carcinogenic risk exceeds 1E-06 or the hazard quotient exceeds 1.

<sup>b</sup> The units are in milligrams per kilogram.

-- Not applicable or not available

COC Chemicals of concern

Conc. Concentration

HQ Hazard Quotient

RME Reasonable maximum exposure

**TABLE 10-6**  
**SITE 22 - BUILDING 7SH5**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**RESIDENTIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Chemicals of Concern (COC) for the RME Case <sup>a</sup>						
Media	RME Risk Assessment Results	Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	Comments	
<b>Surface soil</b>	Cancer Risk	Arsenic (8/8)	82.4	2.2E-04	All eight arsenic concentrations exceed the ambient level for arsenic (15 mg/kg); however, no source of arsenic was identified.	
		Beryllium (1/8)	0.27	1.9E-06	The risk for beryllium is based on a single detected concentration.	
	Hazard Index	Arsenic (8/8)	82.4	3.72	All eight arsenic concentrations exceed the ambient level for arsenic (15 mg/kg); however, no source of arsenic was identified.	
	Lead Evaluation	Lead (15/15)	156	--	Only one lead concentration (165 mg/kg) exceeded the Cal-modified residential PRG (130 mg/kg).	
<b>Subsurface soil</b>	Cancer Risk	Arsenic (31/31)	36.4	9.7E-05	The risk associated with residential exposure to ambient levels of arsenic is 1.9E-05.	
		Beryllium (8/31)	0.43	3.0E-06		
	Hazard Index	Arsenic (31/31)	36.4	1.65	The hazard quotient for residential exposure to ambient levels of arsenic is 0.33.	
	Lead Evaluation	--	--	--	The RME lead concentration in subsurface soil (29 mg/kg) is less than the Cal-modified residential PRG of 130 mg/kg.	

**TABLE 10-6 (Continued)**  
**SITE 22 - BUILDING 7SH5**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**RESIDENTIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Media	RME Risk Assessment Results	Chemicals of Concern (COC) for the RME Case <sup>a</sup>			Comments
		Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	
Groundwater	Cancer Risk 1.6E-05	Trichloroethene (1/3)	0.027	1.6E-05	The risk for trichloroethene was based on a single detection in a grab sample collected from a temporary well. Four monitoring wells have been installed, and analytical results from these wells are necessary to confirm the presence of this chemical.
Hazard Index		0.74	--	--	No noncarcinogenic COCs identified.

<sup>a</sup> The chemicals listed are those for which the carcinogenic risk exceeds 1E-06 or the hazard quotient exceeds 1.

<sup>b</sup> The units are in milligrams per kilogram for soil and milligrams per liter for groundwater.

-- Not applicable or not available

COC Chemicals of concern

Conc. Concentration

HQ Hazard Quotient

RME Reasonable maximum exposure

**TABLE 10-7**  
**SITE 24A - PISTOL FIRING RANGE**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**INDUSTRIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Media	RME Risk Assessment Results	Chemicals of Concern (COC) for the RME Case <sup>a</sup>			Comments
		Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	
<b>Surface soil</b>	Cancer Risk	Arsenic (12/12)	6.7	2.8E-06	The RME concentration (6.7 mg/kg) was less than the ambient level for arsenic (7.3 mg/kg). The risk associated with industrial exposure to ambient levels of arsenic is 1.8E-06.
	Hazard Index	--	--	--	No noncarcinogenic COCs were identified.
	Lead Evaluation	Lead (12/12)	7,110	--	The RME lead concentration is equal to the maximum concentration detected at the site. Five surface soil samples contained lead concentrations greater than the industrial PRG of 1,000 mg/kg. These five samples were collected in the vicinity of the firing berm. Lead concentrations diminish with distance from the target berm.
<b>Subsurface soil</b>	Cancer Risk	Arsenic (25/27)	5.3	2.2E-06	The RME concentration (5.3 mg/kg) was less than the ambient level for arsenic (7.3 mg/kg). The risk associated with industrial exposure to ambient levels of arsenic is 1.8E-06.
		Benzo(a)pyrene (2/2) Other PAHs (2/2)	9.9 2.2 - 26	3.8E-05 3.1E-05	The risks associated with industrial exposure to PAHs were based on the maximum concentrations of these chemicals.

**TABLE 10-7 (Continued)**  
**SITE 24A - PISTOL FIRING RANGE**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**INDUSTRIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Chemicals of Concern (COC) for the RME Case <sup>a</sup>					
Media	RME Risk Assessment Results	Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	Comments
Subsurface soil	0.10	--	--	--	No noncarcinogenic COCs were identified.
(Continued)					
Lead Evaluation	--	Lead (27/27)	7,110	--	The RME lead concentration is equal to the maximum concentration detected at the site. Five surface soil samples contained lead concentrations greater than the industrial PRG of 1,000 mg/kg. These five samples were collected in the vicinity of the firing berm. Lead concentrations diminish with depth and distance from the target berm.

<sup>a</sup> The chemicals (or chemical classes) listed are those for which the carcinogenic risk exceeds 1E-06 or the hazard quotient exceeds 1.

<sup>b</sup> The units are in milligrams per kilogram.

-- Not applicable or not available

COC Chemicals of concern

Conc. Concentration

HQ Hazard Quotient

PAHs Polynuclear Aromatic Hydrocarbons

RME Reasonable maximum exposure



**TABLE 10-8**  
**SITE 24A - PISTOL FIRING RANGE**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**RESIDENTIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Media	RME Risk Assessment Results	Chemicals of Concern (COC) for the RME Case <sup>a</sup>			Comments
		Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	
<b>Surface soil</b>	Cancer Risk	Arsenic (12/12)	6.7	1.8E-05	The RME concentration for arsenic was less than the ambient level for arsenic (7.3 mg/kg). The risk associated with residential exposure to ambient levels of arsenic is 1.2E-05.
		Beryllium (3/12)	0.21	1.5E-06	The RME concentration for beryllium was less than the ambient level for beryllium (0.56 mg/kg). The risk associated with residential exposure to ambient levels of beryllium is 2.2E-06.
	Hazard Index	--	--	--	No chemical-specific hazard quotient exceeds 1.
	Lead Evaluation	Lead (12/12)	7,110	--	The RME lead concentration is equal to the maximum concentration detected at the site. Lead concentrations exceeded the residential PRG for lead (130 mg/kg) in the vicinity of the firing berm and adjacent drainage ditch. Lead concentrations diminish with distance from the target berm.
<b>Subsurface soil</b>	Cancer Risk	Arsenic (25/27)	5.3	1.4E-05	The RME concentrations (5.3 mg/kg) was less than the ambient level for arsenic (7.3 mg/kg). The risk associated with residential exposure to ambient levels of arsenic is 1.2E-05.

**TABLE 10-8 (Continued)**  
**SITE 24A - PISTOL FIRING RANGE**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**RESIDENTIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Media	RME Risk Assessment Results	Chemicals of Concern (COC) for the RME Case <sup>a</sup>			Comments
		Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	
<b>Subsurface Soil (Continued)</b>		Beryllium (7/27)	0.51	3.6E-06	The RME concentration (0.51 mg/kg) was less than the ambient level for beryllium (0.56 mg/kg). The risk associated with residential exposure to ambient levels of beryllium is 2.2E-06.
		Benzo(a)pyrene (2/2) Other PAHs (2/2)	9.9 2.2 - 26	1.6E-04 1.3E-04	The risks associated with residential exposure to PAHs was based on the maximum concentrations of these chemicals.
	Hazard Index	--	--	--	No chemical-specific hazard quotient exceeds 1.
	Lead Evaluation	Lead (27/27)	7,110	--	The RME lead concentration is equal to the maximum concentration detected at the site. Lead concentrations exceeded the residential PRG for lead (130 mg/kg) in the vicinity of the firing berm and adjacent drainage ditch. Lead concentrations diminish with distance from the target berm.

<sup>a</sup> The chemicals (or chemical classes) listed are those for which the carcinogenic risk exceeds 1E-06 or the hazard quotient exceeds 1.

<sup>b</sup> The units are in milligrams per kilogram for soil and milligrams per liter for groundwater.

-- Not applicable or not available

COC Chemicals of concern

Conc. Concentration

HQ Hazard Quotient

PAH Polynuclear Aromatic Hydrocarbon

RME Reasonable maximum exposure

**TABLE 10-9**  
**SITE 27 - BUILDING 1A-20**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**INDUSTRIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Chemicals of Concern (COC) for the RME Case <sup>a</sup>						
Media	RME Risk Assessment Results	Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	Comments	
Surface soil	Cancer Risk 3.5E-05	alpha-Chlordane (19/23)	24	1.6E-05	The RME concentration alpha-Chlordane is equal to the maximum concentration (24 mg/kg) detected at the site. The risk associated with industrial exposure to the average concentration of alpha-Chlordane (3 mg/kg) was 2.0E-06. Alpha-Chlordane concentrations exceeded the industrial PRG (1.5 mg/kg) in only three samples collected around the building foundations.	
		gamma-Chlordane (15/23)	23	1.6E-05	The RME concentration of gamma-Chlordane is equal to the maximum concentration (23 mg/kg) detected at the site. The risk associated with industrial exposure to the average concentration of gamma-Chlordane (4 mg/kg) was 2.7E-06. Gamma-Chlordane concentrations exceeded the industrial PRG (1.5 mg/kg) in only three samples collected around the building foundations.	
Hazard Index	1.2	--	--	--	No chemical-specific hazard quotient exceeds 1.	

**TABLE 10-9 (Continued)**  
**SITE 27 - BUILDING 1A-20**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**INDUSTRIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Media	RME Risk Assessment Results	Chemicals of Concern (COC) for the RME Case <sup>a</sup>			Comments
		Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	
<b>Subsurface soil</b>	<b>Cancer Risk</b>	2.7E-05	15	9.9E-06	alpha-Chlordane - see previous discussion.
		alpha-chlordane (23/31)			
		gamma-chlordane (19/31)	22	1.5E-05	gamma-Chlordane - see previous discussion.
	<b>Hazard Index</b>	0.95	--	--	No noncarcinogenic COCs identified.

<sup>a</sup> The chemicals listed are those for which the carcinogenic risk exceeds 1E-06 or the hazard quotient exceeds 1.

<sup>b</sup> The units are in milligrams per kilogram.

-- Not applicable or not available

COC Chemicals of concern

Conc. Concentration

HQ Hazard Quotient

RME Reasonable maximum exposure

**TABLE 10-10**  
**SITE 27 - BUILDING 1A-20**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**RESIDENTIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Chemicals of Concern (COC) for the RME Case <sup>a</sup>					
Media	RME Risk Assessment Results	Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	Comments
Surface soil	1.5E-04 Cancer Risk	alpha-Chlordane (19/23)	24	7.0E-05	The RME concentration of alpha-Chlordane is equal to the maximum concentration (24 mg/kg) detected at the site. The risk associated with residential exposure to the average concentration of alpha-Chlordane (3 mg/kg) was 8.8E-06.
		gamma-Chlordane (15/23)	23	6.7E-05	The RME concentration of gamma-Chlordane is equal to the maximum concentration (23 mg/kg) detected at the site. The risk associated with residential exposure to the average concentration of gamma-Chlordane (4 mg/kg) was 1.2E-05.
		Aroclor-1248 (5/23)	0.5	2.0E-06	The RME concentrations of Aroclor-1248 and Aroclor-1254 are equal to the maximum concentrations detected at the site.
		Aroclor-1254 (5/23)	1.0	3.9E-06	
		Dieldrin (4/23)	0.07	2.6E-06	The RME concentration of dieldrin is equal to the maximum concentration detected at the site. This value (0.07 mg/kg) was the only concentration to exceed the residential PRG of 0.03 mg/kg.
		4,4'-DDD (7/23)	8	4.4E-06	The RME concentration of 4,4'-DDD is equal to the maximum concentration detected at the site. This value (8 mg/kg) was the only concentration to exceed the residential PRG of 1.9 mg/kg.

**TABLE 10-10 (Continued)**  
**SITE 27 - BUILDING IA-20**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**RESIDENTIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

Media	RME Risk Assessment Results	Chemicals of Concern (COC) for the RME Case <sup>a</sup>			Comments
		Chemical (Detection Frequency)	RME Conc. <sup>b</sup>	Risk/ HQ	
<b>Surface soil (Continued)</b>	Hazard Index	13	alpha-Chlordane (19/23)	24	6.14
					The RME concentration of alpha-Chlordane is equal to the maximum concentration (24 mg/kg) detected at the site. The hazard quotient for residential exposure to the average concentration of alpha-Chlordane (3 mg/kg) was 0.77.
<b>Subsurface soil</b>	Cancer Risk		gamma-Chlordane (15/23)	23	5.88
					The RME concentration of gamma-Chlordane is equal to the maximum concentration (23 mg/kg) detected at the site. The hazard quotient for residential exposure to the average concentration of gamma-Chlordane (4 mg/kg) was 1.0.
		1.2E-04	alpha-Chlordane (23/31)	15	4.3E-05
	Hazard Index		gamma-Chlordane (19/31)	22	6.4E-05
					gamma-Chlordane - see previous discussion
			Aroclor-1248 (6/31)	0.5	2.0E-06
			Aroclor-1254 (5/31)	1.0	3.9E-06
			Dieldrin (4/31)	0.07	2.6E-06
					Dieldrin - see previous discussion
		10	alpha-Chlordane (23/31)	15	3.72
					alpha-Chlordane - see previous discussion
			gamma-Chlordane (19/31)	22	5.62
					gamma-Chlordane - see previous discussion

**TABLE 10-10 (Continued)**  
**SITE 27 - BUILDING IA-20**  
**SUMMARY OF HUMAN HEALTH RISKS AND HAZARDS**  
**RESIDENTIAL SCENARIO**  
**NWS CONCORD, INLAND AREA SITES**

**Notes:**

- a** The chemicals listed are those for which the carcinogenic risk exceeds 1E-06 or the hazard quotient exceeds 1.
- b** The units are in milligrams per kilogram.
- Not applicable or not available
- COC** Chemicals of concern
- Conc.** Concentration
- HQ** Hazard Quotient
- PRG** Preliminary remediation goal
- RME** Reasonable maximum exposure

TABLE 10-11

**SUMMARY OF CANCER RISK AND HAZARD INDEX  
FOR INDUSTRIAL EXPOSURE TO AMBIENT LEVELS AT SITE 13 AND SITE 22**

**NWS CONCORD, INLAND AREA SITES**

METAL	RME CONC. (mg/kg)	INDUSTRIAL PRG		CANCER RISK	HAZARD QUOTIENT
		CANCER	NONCANCER		
Aluminum	1.7E+04	--	1.7E+06	--	< 0.01
Antimony	5.2E-01	--	6.8E+02	--	< 0.01
Arsenic	7.2E+00	2.4E+00	3.8E+02	3.0E-06	0.02
Barium	3.1E+02	--	1.1E+05	--	< 0.01
Beryllium	4.5E-02	1.1E+00	8.5E+03	4.1E-08	< 0.01
Cadmium	6.9E-02	1.9E+01	8.5E+02	3.6E-09	< 0.01
Chromium	5.1E+01	--	1.5E+06	--	< 0.01
Cobalt	2.0E+01	--	9.7E+04	--	< 0.01
Copper	4.5E+01	--	6.3E+04	--	< 0.01
Lead	1.3E+01	--	--	--	--
Manganese	8.5E+02	--	4.3E+04	--	0.02
Mercury	1.2E-01	--	6.8E+01	--	< 0.01
Nickel	7.3E+01	3.1E+02	3.4E+04	2.4E-07	< 0.01
Thallium	4.4E-01	--	1.4E+02	--	< 0.01
Vanadium	7.4E+01	--	1.2E+04	--	< 0.01
Zinc	8.1E+01	--	5.1E+05	--	< 0.01
<b>TOTAL:</b>				<b>3.3E-06</b>	<b>0.04</b>

Notes:

RME CONC. Reasonable maximum exposure concentration  
mg/kg Milligrams per kilogram  
PRG Preliminary Remediation Goal (EPA 1996b)



TABLE 10-12

**SUMMARY OF CANCER RISK AND HAZARD INDEX  
FOR RESIDENTIAL EXPOSURE TO AMBIENT LEVELS AT SITE 13 AND SITE 22**

**NWS CONCORD, INLAND AREA SITES**

METAL	RME CONC. (mg/kg)	RESIDENTIAL PRG		CANCER RISK	HAZARD QUOTIENT
		CANCER	NONCANCER		
Aluminum	1.7E+04	--	7.7E+04	--	0.22
Antimony	5.2E-01	--	3.1E+01	--	0.02
Arsenic	7.2E+00	3.8E-01	2.2E+01	1.9E-05	0.33
Barium	3.1E+02	--	5.3E+03	--	0.06
Beryllium	4.5E-02	1.4E-01	3.8E+02	3.2E-07	< 0.01
Cadmium	6.9E-02	9.0E+00	3.8E+01	7.7E-09	< 0.01
Chromium	5.1E+01	--	6.6E+04	--	< 0.01
Cobalt	2.0E+01	--	4.6E+03	--	< 0.01
Copper	4.5E+01	--	2.8E+03	--	0.02
Lead	1.3E+01	--	--	--	--
Manganese	8.5E+02	--	3.2E+03	--	0.27
Mercury	1.2E-01	--	6.5E+00	--	0.02
Nickel	7.3E+01	1.5E+02	1.5E+03	4.9E-07	0.05
Thallium	4.4E-01	--	6.1E+00	--	0.07
Vanadium	7.4E+01	--	5.4E+02	--	0.14
Zinc	8.1E+01	--	2.3E+04	--	< 0.01
<b>TOTAL:</b>				<b>2.0E-05</b>	<b>1.2</b>

Notes:

RME CONC. Reasonable maximum exposure concentration  
 mg/kg Milligrams per kilogram  
 PRG Preliminary Remediation Goal (EPA 1996b)

TABLE 10-13

**SUMMARY OF CANCER RISK AND HAZARD INDEX  
FOR INDUSTRIAL EXPOSURE TO AMBIENT LEVELS AT SITE 17 AND SITE 24A**

**NWS CONCORD, INLAND AREA SITES**

METAL	RME CONC. (mg/kg)	INDUSTRIAL PRG		CANCER RISK	HAZARD QUOTIENT
		CANCER	NONCANCER		
Aluminum	1.3E+04	--	1.7E+06	--	< 0.01
Antimony	5.6E-01	--	6.8E+02	--	< 0.01
Arsenic	4.4E+00	2.4E+00	3.8E+02	1.8E-06	0.01
Barium	1.5E+02	--	1.1E+05	--	< 0.01
Beryllium	3.2E-01	1.1E+00	8.5E+03	2.9E-07	< 0.01
Cadmium	4.6E-02	1.9E+01	8.5E+02	2.4E-09	< 0.01
Chromium	3.1E+01	--	1.5E+06	--	< 0.01
Cobalt	1.6E+01	--	9.7E+04	--	< 0.01
Copper	3.1E+01	--	6.3E+04	--	< 0.01
Lead	9.6E+00	--	--	--	--
Manganese	5.8E+02	--	4.3E+04	--	0.01
Mercury	4.4E-02	--	6.8E+01	--	< 0.01
Nickel	3.3E+01	3.1E+02	3.4E+04	1.0E-07	< 0.01
Vanadium	5.3E+01	--	1.2E+04	--	< 0.01
Zinc	5.9E+01	--	5.1E+05	--	< 0.01
<b>TOTAL:</b>				<b>2.2E-06</b>	<b>0.03</b>

Notes:

RME CONC. Reasonable maximum exposure concentration  
 mg/kg Milligrams per kilogram  
 PRG Preliminary Remediation Goal (EPA 1996b)

TABLE 10-14

**SUMMARY OF CANCER RISK AND HAZARD INDEX  
FOR RESIDENTIAL EXPOSURE TO AMBIENT LEVELS AT SITE 17 AND SITE 24A**

**NWS CONCORD, INLAND AREA SITES**

METAL	RME CONC. (mg/kg)	RESIDENTIAL PRG		CANCER RISK	HAZARD QUOTIENT
		CANCER	NONCANCER		
Aluminum	1.3E+04	--	7.7E+04	--	0.17
Antimony	5.6E-01	--	3.1E+01	--	0.02
Arsenic	4.4E+00	3.8E-01	2.2E+01	1.2E-05	0.20
Barium	1.5E+02	--	5.3E+03	--	0.03
Beryllium	3.2E-01	1.4E-01	3.8E+02	2.2E-06	< 0.01
Cadmium	4.6E-02	9.0E+00	3.8E+01	5.1E-09	< 0.01
Chromium	3.1E+01	--	6.6E+04	--	< 0.01
Cobalt	1.6E+01	--	4.6E+03	--	< 0.01
Copper	3.1E+01	--	2.8E+03	--	0.01
Lead	9.6E+00	--	--	--	--
Manganese	5.8E+02	--	3.2E+03	--	0.18
Mercury	4.4E-02	--	6.5E+00	--	< 0.01
Nickel	3.3E+01	1.5E+02	1.5E+03	2.2E-07	0.02
Vanadium	5.3E+01	--	5.4E+02	--	0.10
Zinc	5.9E+01	--	2.3E+04	--	< 0.01
<b>TOTAL:</b>				<b>1.4E-05</b>	<b>0.73</b>

Notes:

RME CONC. Reasonable maximum exposure concentration  
 mg/kg Milligrams per kilogram  
 PRG Preliminary Remediation Goal (EPA 1996b)

TABLE 10-15

**CHEMICALS OF POTENTIAL CONCERN THAT EXCEED  
SOIL SCREENING LEVELS  
NWS CONCORD, INLAND AREA SITES**

Site	Chemical	RME Conc. <sup>a</sup> (mg/kg)	Frequency of Detection <sup>b</sup>	SSL <sup>c</sup> (mg/kg)
13	2,4-dinitrotoluene	1.2E-01	1/131	8.0E-04
17	--	--	--	--
22	Arsenic	3.2E+01	35/35	2.9E+01
24A	Antimony	2.8E+01	11/27	5.0E+00
	Lead	7.1E+03	27/27	4.0E+02
	Benzo(a)anthracene	2.5E+01	2/2	2.0E+00
	Benzo(a)pyrene	9.9E+00	2/2	8.0E+00
	Benzo(b)fluoranthene	1.3E+01	2/2	5.0E+00
	Carbazole	2.0E+01	2/2	6.0E-01
	Dibenz(a,h)anthracene	2.2E+00	2/2	2.0E+00
27	Pentachlorophenol	7.8E-02	1/19	3.0E-02
	Alpha-chlordane	1.5E+01	23/31	1.0E+01
	Dieldrin	7.3E-02	4/31	4.0E-03
	Gamma-chlordane	2.2E+01	19/31	1.0E+01

<sup>a</sup> The reasonable maximum exposure (RME) concentration was calculated using soil data collected from 0 foot to the maximum depth sampled.

<sup>b</sup> The frequency of detection is based on samples collected from 0 feet to the maximum depth sampled.

<sup>c</sup> The soil screening levels (SSL) are from the Soil Screening Guidance: Technical Background Document and were developed using a default dilution and attenuation factor (DAF) of 20 (EPA 1996d).

-- No chemicals at this site exceeded the SSLs  
mg/kg Milligrams per kilogram

## **11.0 QUALITATIVE ECOLOGICAL RISK ASSESSMENT**

This section describes the ecological risk assessment (ERA) conducted at the NWS Concord Inland Area site. The approach for evaluating ecological risks was initially developed in the RI/FS Inland Area Sites Ecological Assessment Draft Final Work Plan (PRC/Montgomery Watson 1995a). The details of field sampling procedures were outlined in the RI/FS Inland Area Sites Draft Final Field Sampling Plan (PRC/Montgomery Watson 1995b). Issues related to quality control were presented in the RI/FS Inland Area Sites Draft Final Quality Assurance Project Plan (PRC/Montgomery Watson 1995c).

### **11.1 ECOLOGICAL RISK ASSESSMENT APPROACH**

The technical approach presented in the work plan focused on (1) identifying ecological receptors at risk; (2) identifying chemicals of ecological concern (COECs); (3) identifying potentially complete exposure pathways; (4) formulating a conceptual site model; and (5) characterizing and evaluating risk using a weight-of-evidence approach. The original technical approach was supplemented with standard risk assessment procedures recommended by U.S. Environmental Protection Agency (EPA) and California Environmental Protection Agency (Cal/EPA) Department of Toxic Substances Control (DTSC) guidance, as well as by American Society for Testing and Materials (ASTM) methods. In addition, the Navy has been developing a regional approach to ERAs at naval installations in the San Francisco Bay region in conjunction with the Biotechnical Advisory Group (BTAG) to ensure that the most appropriate tools and approaches are incorporated into all Navy risk assessments. One tool identified in the regional approach that was included in this risk assessment, though not specifically mentioned in the work plan, is food-chain modeling and evaluation of potential risks to higher-level receptors from dietary intake of chemicals. An overview of available guidance and the regional approach is discussed in the following sections and should be considered as a refinement of the original work plan.

#### **11.1.1 The Framework Approach**

The approach for the ERA at the Inland Area sites was developed using guidance outlined by EPA, including "Risk Assessment Guidance for Superfund: Volume II, Environmental Evaluation Manual" (EPA 1989b); "Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference"

(EPA 1989a); "The Nature and Extent of Ecological Risks at Superfund Sites and RCRA Facilities" (EPA 1989c); "A Framework for Ecological Risk Assessment" (EPA 1992a); and "Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities" (DTSC 1994a). ERAs for contaminated sites are typically conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the Resource Conservation and Recovery Act (RCRA), especially if endangered species, critical habitats, or large geographical areas are of concern.

Regardless of the tools applied to the process, a classic ERA is generally composed of four basic, interactive steps, which vary as a function of the level of effort needed to address regulatory requirements rather than their conceptual content. These four steps, (1) problem formulation, (2) exposure assessment, (3) ecological effects assessment, and (4) risk characterization, are discussed in detail below.

#### **11.1.2 Problem Formulation**

Problem formulation establishes the goals, breadth, and focus of the assessment. It is a systematic approach that identifies the main factors to be considered in the ERA, which includes historical characterization of the site, ecological characterization of the area, selection of risk-based screening guidelines, evaluation and identification of COECs, identification of receptors and endpoints of concern (including federal- and state-protected species), and an overall characterization of the ecosystem at risk due to chemical releases.

The identification of COECs is based on comparison of site samples to ambient concentrations of chemicals and to relevant screening guidelines. Ambient concentrations are those chemical concentrations not influenced by anthropogenic sources, while ambient concentrations are typical, area-wide or regional concentrations of compounds, including anthropogenically derived chemicals. In addition, the spatial distribution and relative concentrations of chemicals in the environmental media are considered.

Site-specific ecological receptors of concern may be year-round residents or migratory species exposed to chemicals at the site during their period of residence. Exposure of receptors to chemicals on site occurs through direct contact with contaminated media as well as through ingestion of chemicals

accumulated in prey. Dominant routes of exposure of site-specific receptors to chemical stressors are predicted based on the nature of COECs and the types of receptors at the site. Problem formulation results in a site conceptual model that identifies the scope and goals of the risk assessment. This information may then be used to determine what assessment and measurement endpoints are appropriate to characterize potential risk to receptors from site contamination.

#### **11.1.3 Exposure Assessment**

Following the problem formulation phase, assessment of both exposure and ecological effects must be completed (EPA 1992a). The exposure analysis details the release, migration, and fate of potential COECs. The spatial distribution and temporal variability of chemical data are evaluated with natural history data on the ecological receptors at the site to develop an exposure scenario for each receptor. A conceptual food web for the site, combined with chemical- and receptor-specific exposure information, allows estimates of exposure point concentrations of COECs. Food chain modeling is one tool to evaluate whether exposure to chemicals in the diet poses an ecological risk. Exposure assessment includes an evaluation of the biotic and abiotic factors that influence exposure, including biogeochemical interactions, natural history, climatic variations, site features, and chemical properties. Habitats and receptors at risk were evaluated using an integrated approach originally designed for hazard assessment (Dickson and Others 1979; Bergman and Others 1986; Dickson and Others 1987; EPA 1989a; Suter 1990).

#### **11.1.4 Effects Assessment**

The ecological effects assessment, conducted in parallel with the exposure assessment, addresses the toxicological properties of site-specific COECs and evaluates whether ecological receptors may be adversely affected by site chemicals. Depending on the level of effort devoted to an evaluation of ecological effects, a detailed biological assessment can be conducted as part of the ecological effects assessment. Biological assessments include site-specific screening tools such as bioassays and estimates of ingested doses of chemicals by receptors derived from food chain analyses. These estimates are compared to toxicity-based screening values to evaluate direct and indirect effects of chemicals on receptors.

#### **11.1.5 Risk Characterization**

Risk characterization integrates the information gained during the assessment of exposure and ecological effects and describes the relationship between potential environmental stressors and adverse ecological effects. Existing site-specific information and reviews of scientific literature are used to evaluate the risk posed by site-specific chemicals. The available information is used in a weight-of-evidence approach to characterize risk to endpoints of concern, as described in Pascoe and others (1994a, 1994b) and Linder and others (1994b). The degree of confidence in the risk assessment is evaluated by identifying important sources of uncertainty, as well as underlying assumptions in the analysis. Based on the risk characterization, risk management decisions and recommendations concerning future site activities are made.

#### **11.1.6 Overview of the ERA Approach for the Inland** **Error! Bookmark not defined. Area**

Potential risk to ecological receptors at five sites was evaluated in this Inland Area ERA. The five sites, listed below, are briefly described in Section 11.2.

- Site 22 (Building 7SH5)
- Site 24A (Pistol Firing Range)
- Site 27 (Building IA-20)
- Site 13 (Burn Area)
- Site 17 (Building IA-24 Pipe Discharge, Seal Creek)

#### **11.2 INLAND AREA SITE CHARACTERIZATION AND PROBLEM FORMULATION**

NWS Concord is located in the north-central portion of Contra Costa County, California, about 30 miles northeast of San Francisco. The facility, which encompasses about 13,000 acres, is bounded by Suisun Bay to the north, by the city of Concord to the south and west, and the towns of Pittsburg and Bay Point to the east (see Figure 1-1). Currently, the facility contains three main separate land holdings: the Tidal Area, the Inland Area, and a radiography facility in Pittsburg, California.



The Inland Area of NWS Concord encompasses about 6,200 acres and is separated from the Tidal Area by the town of Clyde and Los Medanos Hills, which are not owned by the Navy. A Navy-owned road and rail line link the two areas. Seal Creek (also known as Mt. Diablo Creek) flows through the Inland Area, roughly parallel to Kinne Boulevard, into Hastings Slough in the western portion of the Tidal Area, and eventually into Suisun Bay.

### **11.2.1 Descriptions of Sites in the Inland Area**

The five Inland Area sites are discussed in greater detail in Sections 5.0 through 9.0, which include site-specific nature and extent sections focused on site history, previous investigations, RI field activities, chemical characterization and results for the RI sampling. The five sites of the Inland Area differ in several important ways, including (1) history of chemical releases; (2) levels of chemicals; (3) habitat value; and (4) potential for risk to ecological receptors. These features of each site are described below; followed by rationale for the level of risk analysis performed at each site.

#### **11.2.1.1 Site 22 - Building 7SH5**

Building 7SH5 is located along the southwestern portion of the base (Figure 1-3). The building was formerly a missile wing and fin repair facility. Building operations include paint stripping, cleaning, and repainting missile wings and fins. Missile repair required the use of acetone, trichloroethane, methyl ethyl ketone, chloroethane, and several types of paint thinners. Building 7SH5 (Figure 7-1) is currently used for manufacturing mobile laboratories to be used during EOD activities. Until 1978, the Tidal Area Landfill (Site 1) reportedly received all wastes from Building 7SH5. Since 1978, wastes have been disposed of off base.

The initial assessment study (IAS) reported that paints, oil, and solvents may have been disposed of in a 24-inch-deep earthen pit or into a nearby drainage ditch near Building 7SH5 (E&E 1983). The suspected disposal pit was reportedly backfilled. IT Corp. identified the parking lot near the southwest corner of Building 7SH5, where a section of the pavement is missing, as the possible location of the pit (IT Corp. 1989) (Figure 7-1); however, this location was later identified following the RI as a possible excavation for a water line repair. The RI findings are discussed further in Sections 7.3 and 7.5. The drainage ditch is located along the southeastern and southwestern sides of the building (Figure 7-1).

### **Additional Site Information**

Soil samples collected at Site 22 were analyzed for metals, SVOCs, VOCs, TPH-extractables, TOC, grain size, pH and geophysical parameters. Table 7-2 lists the parameters that were analyzed for at each location and the total number of samples analyzed. Tables 7-4 through 7-7 show all detected concentrations of analytes at each location. A detailed discussion on the results of the chemical analyses for Site 22 appears in Section 7.0.

About 80 percent of the site is occupied by the building and paved areas. The remaining surface areas have little vegetation. No animals were observed in the area during site visits (PRC 1993d). Exposure to receptors off-site was considered unlikely, given the volatile nature of VOCs and SVOCs.

No ERA was warranted at this site for the following reasons:

- Lack of viable habitat at or adjacent to this site
- Limited site use by ecological receptors
- Completed removal action

#### **11.2.1.2 Site 24A - Pistol Firing Range**

The Pistol Firing Range has been in use since at least the mid-1960s. Although the site was investigated under the IR program, it has since been removed from the IR program because its active status. All future maintenance and environmental work at Site 24A will be conducted by NWS Concord personnel or its subcontractors. The Pistol Firing Range is located in Los Medanos Hills near Building IA-57, east of Kinne Boulevard at the end of a gravel road off the east end of Wilden Road (Figure 1-3). The intersection of Wilden Road and Kinne Boulevard is approximately 3.5 miles from the front gate of NWS Concord. An earthen berm constructed on the eastern side of the firing range serves as a backstop behind the target area (Figure 8-1). This berm is referred to as the target berm in this report. In the late 1970s or early 1980s, a project reportedly was undertaken to replace the original target berm. The removal of lead from the old berm was regarded as cost prohibitive, so the berm was capped with soil of unknown thickness to create the current berm.

The ammunition fired at the range varies from small caliber to 50-caliber rounds. The target berm is the study area of this site because of potential metal contamination from the lead-centered, copper-jacketed projectiles that penetrate the berm. Soil samples were collected from the berm to quantify the metal concentrations in the soil from metal projectiles.

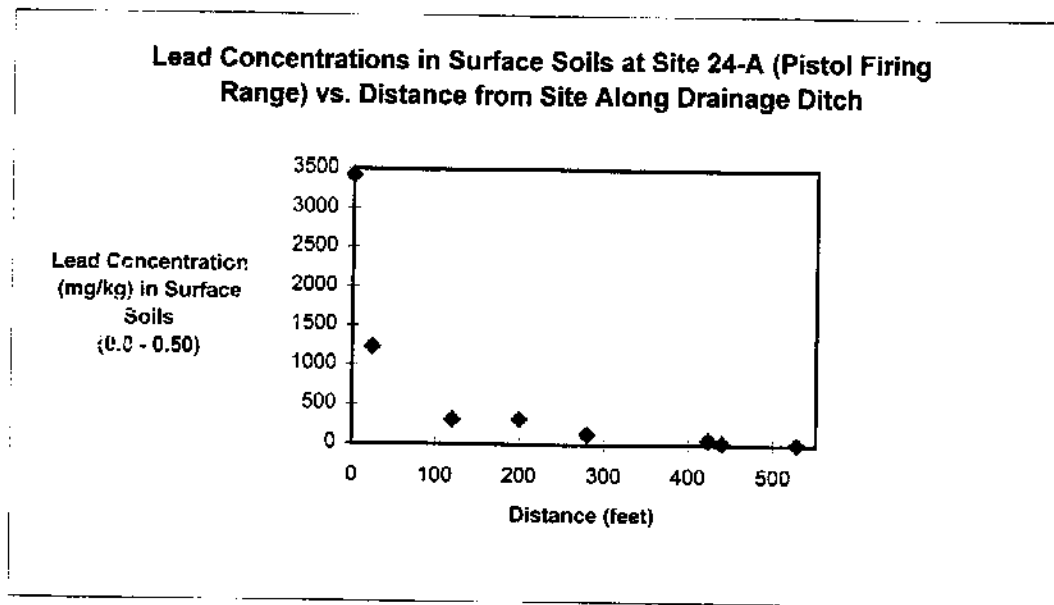
#### **Additional Site Information**

Soil samples collected at Site 24A were analyzed for metals, SVOCs, TOC, grain size, pH and geophysical parameters. A waste extraction test (WET) using deionized (DI) water was also performed on these samples. Table 8-2 lists the parameters that were analyzed for at each location and the total number of samples analyzed. Tables 8-3 and 8-4 show all detected concentrations of analytes at each location. A detailed discussion on the results of the chemical analyses for Site 24A can be found in Section 8.0 of this report.

Habitat at the site consists of non-native disturbed grassland typical of the upland areas throughout NWS Concord. Small mammal receptors, particularly California ground squirrels, were abundant during daylight hours during visual surveys. Avian fauna were less evident, as might be expected based on distance to cover, lack of surface water, and frequency of gunshots in the area. Habitat value was considered marginal due to the small size of the site, disturbed grassland vegetation type, and the level of human disturbance of the site.

Potential exposure points to chemicals originating at Site 24A include (1) direct contact with the berm soils where ammunition is deposited and (2) contact with residues carried in storm water runoff and subsurface leaching. Trophic transfer of chemicals to predators of small mammals was discounted due to the small size of the affected area relative to the abundance of small mammal prey.

To address the potential migration of lead off-site, the spatial distribution of lead concentrations in surface soils was evaluated. Lead levels decrease dramatically within a few hundred feet of the site. The chart below depicts levels of lead in soil borings at various distances from the firing range:



In addition, in those soil borings where deeper samples were analyzed, lead concentrations decreased with depth, indicating attenuation of lead concentrations.

No ERA was completed at this site for the following reasons:

- Marginal habitat value of the site
- Attenuation of lead near the site
- Active status of firing range

The transport of dissolved lead off-site is of potential concern. Because this site is currently active and slated to remain so, potential off-site migration of lead is best addressed through management techniques such as control of surface water runoff. Best management practices (BMP) should be incorporated by NWS Concord for management of this site.

#### **11.2.1.3 Site 27 - Building IA-20**

Site 27 consists of the area north and on either side of Building IA-20, which is located on the eastern side of H Street about 800 feet southeast of the State Highway 4 underpass (Figure 1-3). Adjacent to Building IA-20 is Building IA-36, a boiler house (Figure 9-1). Building IA-20 houses the chemical laboratory and a materials testing laboratory of the Weapons Quality Engineering Center (WQEC)

Scientific and Engineering Division. The chemical laboratory is primarily used to test oils and hydraulic fluids and to develop new weapons test methods. The materials testing laboratory evaluates the structural integrity and dynamics of ordnance casings, shells, and missiles. Along the southwestern side of Building IA-36 is a 10,000-gallon diesel underground storage tank and vadose zone well.

#### **Additional Site Information**

Soil samples collected at Site 27 were analyzed for PCBs/pesticides, VOCs, SVOCs, TPH- extractables, TOC, grain size, pH and geophysical parameters. Table 9-2 lists the parameters that were analyzed for at each location and the total number of samples analyzed. Tables 9-3 through 9-5 show all detected concentrations of analytes at each location. A detailed discussion on the results of the chemical analyses for site 27 can be found in Section 9.0 of this report.

No significant habitat exists at the site, which is almost entirely covered by buildings and pavement.

No ERA was conducted at this site based on the lack of available habitat at or adjacent to the site.

#### **11.2.1.4 Site 13 - Burn Area**

The Burn Area is located in the western portion of the Inland Area of NWS Concord between the Landing Field and Kinne Boulevard. (Figure 1-3). It lies within the area bounded on the west by Wake Way and on the southeast by Tarawa Way (Figure 5-1). The Contra Costa Canal runs parallel to Wake Way along the western side of the road. Portions of the approximately 1,100- by 1,400-foot area were used for the destruction of live ordnance. Most of the ordnance was reportedly destroyed by burning in large trenches and gullies. The IAS indicated that the trenches were excavated specifically for this purpose (E&E 1983). Additionally, some burning occurred in gullies formed by natural erosion processes. A public works department (PWD) representative at NWS Concord indicated that some of the trenches were created to construct additional railcar revetments; however, this construction was canceled after their initial excavation (Evans 1992).

### **Additional Site Information**

Soil samples collected at Site 13 were analyzed for metals, SVOCs, VOCs, TPH-extractables, dioxins, TOC, grain size, pH and geophysical parameters. Table 5-2 lists the parameters that were analyzed for at each location and the total number of samples analyzed. Tables 5-4 through 5-7 show all detected concentrations of analytes at each location.

Analyses completed specifically for the ERA included a soil bioassay (organic extract Microtox) and WET DI. These tests were performed only on surface samples from randomly selected locations. A total of 35 samples were analyzed for WET DI metals and 7 samples underwent bioassay testing with Microtox. The sampling locations are shown on Figure 5-11.

The habitat of this area is disturbed grasslands, subject to cattle grazing. The vegetation is dominated by yellow thistle and non-native grasses. The burned areas in the trenches often have gravelly soils and are typically devoid of vegetation (PRC/Montgomery Watson 1993a).

As stated in the work plan (PRC/Montgomery Watson 1995a), an ERA was warranted at this site based on the following factors:

- Magnitude and extent of contamination
- Vegetation stress observed at the site
- Relative accessibility of the site to wildlife

A qualitative environmental assessment including evaluation of risk to higher trophic level receptors was performed at this site.

#### **11.2.1.5 Site 17 - Building IA-24 and Seal**

Building IA-24 is located along the eastern side of Kinne Boulevard, approximately 3 miles from the front gate (Figure 1-3). Forklift maintenance operations and forklift battery recharge facilities are located in Building IA-24 and adjacent storage sheds, Buildings IA-24A and IA-24B (Figure 6-1). An asphalt parking lot for forklifts is located along the southeastern wall of Building IA-24. There are differing accounts of an earthen battery acid disposal sump that was reportedly present in the area. There

is no official documentation on the existence or use of the acid sump. The IAS reported that a sump that existed near Building IA-24 and received forklift battery acid waste for at least 20 years prior to 1974. Forklift batteries were processed for disposal at a rate of one per day. Acid from these batteries was reportedly disposed into the earthen sump at a rate of 20 gallons per day (E&E 1983). IT Corp later reported that the acid was disposed in the sump at a rate of 20 gallons per year, which seems a more probable quantity based on the number of forklifts serviced. The IAS reported the location of the sump to be the southeast corner of Building IA-24. The information presented in the IAS was based on interviews with station personnel. The earthen sump was reportedly backfilled in 1974 and its exact location is unknown (IT Corp.1989). Numerous soil sampling locations have been investigated near the suspected locations of the acid sump. Despite the excavation of three trenches, drilling of 28 soil borings, and analysis of 58 soil samples and 11 groundwater samples, there is no evidence of a sump in the area of the reported activity.

As part of forklift maintenance, the forklifts and batteries were steam cleaned to remove oil and grease. The steam cleaner formerly discharged condensate, oil, and grease through a pipeline from the southwestern side of Building IA-24 into Seal Creek (Figure 6-1); however, the steam cleaner has not been used since 1988.

In addition, NWS Concord personnel park 3-ton trucks on the unpaved areas between Buildings IA-24 and IA-55. A 1,000-gallon diesel UST is located near the northwestern corner of Building IA-55 and a 2,000-gallon diesel UST was located west of Building IA-24 (Figure 6-1). In 1987, shallow vadose-zone wells were installed adjacent to the USTs to monitor vadose zone vapors in the vicinity of each tank. A faint diesel odor was reported from the surface down to 5 feet while drilling the Building IA-55 vadose-zone well in December 1987 (ERM-West 1989). A petroleum odor was reported between depths of 4 feet to 8 feet bgs while drilling the Building IA-24 vadose-zone well in December 1987 (ERM-West 1989). The integrity of each tank was checked by precision testing in January 1988 and annually thereafter. The Building IA-55 tank passed the test; however, the Building IA-24 tank did not and was replaced with an aboveground tank.

### **Additional Site Information**

Soil and sediment samples collected at Site 17 were analyzed for metals, SVOCs, VOCs, TPH-extractables and purgeables, WET-DI water, TOC, grain size, pH and geophysical parameters. Table 6-2 lists what parameters were analyzed for at each location and the total number of samples analyzed. Tables 6-4 through 6-7 show all detected concentrations of analytes at each location.

The WET test using DI water was conducted only on surface samples collected from randomly selected locations. Six soil and sediment samples were analyzed for WET DI metals. Only one sample from the bank of Seal Creek was included in the ecological assessment because metals were detected in this sample at concentrations exceeding ambient water quality criteria (AWQC).

No ERA investigation was conducted at the site in light of the lack of significant habitat immediately near the building and minimal use of the site by area fauna. However, the habitat value of Seal Creek is significant, and the potential for ecological impact to riparian receptors at the Seal Creek area from the discharge of the steam pipe was evaluated in this risk assessment. The risk assessment was limited to screening chemicals detected in sediment samples (and a single soil sample) against toxicity-based guidelines.

Overall ecological effects on the riparian habitat of Seal Creek resulting from general operations should be addressed more comprehensively within the context of the NWS Concord natural resources management plan.

#### **11.2.2 Methods of Screening Chemicals**

This section outlines the approach for screening chemicals, while Section 11.2.3 discusses the actual screening results.

This ERA evaluated risks on a site-specific basis for Inland Area Sites 13 and 17 only. The screening included a comparison of chemical data to available screening values and a preliminary evaluation of bioaccumulation potential. The chemicals that exceeded the screening values or exhibited a high bioaccumulation potential were considered COECs. Exposure and effects assessment, which included a



linear food-chain analysis of potential risk to higher-level receptors, were conducted on those COECs for which sufficient ecotoxicological and site-specific data were available.

The detected results for all five of the Inland Area Sites are discussed in Sections 5.0 through 9.0 of this report. Appendix J includes all analytical data collected for the investigations at the Inland Area. The following sections describe the screening methods.

#### **11.2.2.1 Primary Screening**

The purpose of the primary screening was to identify COECs at Inland Area Sites 13 and 17. This screening process compared site concentrations to available screening criteria or values, including ambient concentrations.

#### **Ambient Chemical Concentrations**

Concentrations of 16 inorganic chemicals detected in soil and sediment samples were compared to ambient concentrations derived from upgradient surface and subsurface soil samples from 0.5 to 10 feet bgs collected during the Inland Area RI (Section 5.4). Ambient concentrations were estimated as the 80<sup>th</sup> percent lower confidence limit on the 95<sup>th</sup> percentile of the reported values from this study. One set of ambient concentrations was derived for the alluvial sediments where Site 13 is located and another set for the Los Medanos Hills geologic unit where Site 17 is located. The ambient concentrations provide a baseline for screening levels of inorganic chemicals to focus further study on chemicals and sampling locations that may represent site releases. Inland Area ambient concentrations were derived for most metals except molybdenum, silver, and selenium. Appendix A contains more information on the development of the ambient concentrations.

#### **Regulatory Criteria and Other Screening Values**

Chemical concentrations at Inland Area Sites 13 and 17 were compared to screening values and regulatory criteria derived from direct toxicity tests or biological effects data. Regulatory criteria are commonly used for sediments; however, benchmarks available for soils are more limited in their applicability. Soil screening benchmarks (presented in Table 11-1) provided context in which to interpret chemical concentrations, but were not formal screening values.

Sediment concentrations in Seal Creek at Site 17 were compared to effects range-median (ER-M) values (Long and others 1995) because (1) the creek is inhabited by freshwater invertebrates; and (2) sediment may be transported via surface water to marine habitats. The ER-M values are based on chemical and biological effects data from a wide variety of studies on invertebrates in marine and estuarine sediments, including the NOAA (1991) database. The ER-M represents the 50<sup>th</sup> percentile or median of the effects data. At concentrations above the ER-M, adverse biological effects are expected. These adverse effects may include mortality or sublethal effects such as reduced growth or reproductive success.

Concentrations of inorganic chemicals in leachate extractions were compared to ambient water quality criteria (EPA 1992d). The ambient water quality criteria (AWQC) are based on toxicity tests and are meant to be protective of aquatic life. Chronic values for freshwater were used in the screening process.

### **Bioaccumulating Chemicals**

Many of the screening values outlined above do not account for the potential for bioaccumulation or biomagnification of chemicals. These terms can be defined as follows:

- **Bioaccumulation:** accumulation of a substance by an organism as a result of uptake directly from all environmental sources (ASTM 1995b).
- **Biomagnification:** the increase in tissue concentration of poorly depurated materials in organisms along a series of predator-prey associations, primarily through the mechanism of dietary accumulation; or the tendency of some chemicals to accumulate to higher concentrations in the food web through dietary accumulation (Suter 1993).

Bioaccumulation was addressed directly in the secondary screening using food-chain transfer models. This process is described in Section 11.2.2.2.

### **Detected Chemicals with No Screening Values**

Screening values or regulatory criteria have not yet been developed for many chemicals. A chemical without a screening value was considered a COEC if it was detected in at least 10 percent of samples or occurred in a distribution that suggested on-site release. Insufficient literature on the ecotoxicological effects of some of those chemicals may have, in some cases, limited further consideration.

## **Evaluation of Detection Limits**

If detection limits are higher than screening criteria or values, nondetect data cannot be used to evaluate risk. Detection limits achieved with standard CLP methods for most metals are usually lower than screening values such as effects range-low (ER-L) values; however, detection limits achieved with contract laboratory program (CLP) methods for organic compounds are often higher than available screening values.

Surface soil and sediment samples collected from Inland Area Sites 13 and 17 were analyzed using low detection limit methods for SVOCs, pesticides, and PCBs to achieve detection limits that were below or near screening values. Due to high percent moisture and matrix interference in many samples, the low detection limits were not always achieved.

Based on summary statistics (median and range) of detection limits achieved in the analysis of soil and sediment, samples were compared to available screening values to evaluate the adequacy of detection limits in the ERA context (Tables 11-2 and 11-3). If the median detection limit was greater than the screening value, then non-detects were viewed with caution in the interpretation of risk.

## **Identification of COECs**

A chemical detected at Inland Area Site 13 (Burn Area) was identified as a COEC if it met one of the following conditions:

- The concentration of a metal in soil exceeded the ambient concentration established for site 13 (Appendix A) in at least 10 percent of the samples.
- The concentration of an inorganic chemical in WET extract exceeded the freshwater chronic AWQC in at least 10 percent of the samples.
- A detected chemical for which no screening values were available was considered a COEC; however, limited toxicological information on these chemicals precluded further analysis.

A chemical detected at Inland Area Site 17 (Seal Creek) was identified as a COEC if it met any of the following conditions:

- The concentration of a metal in sediment exceeded the ambient concentration established for site 17 (Appendix A).
- The concentration of an inorganic or organic chemical in sediment exceeded the effects range-median (ER-M) value (Long and Others 1995; National Oceanic Atmospheric Administration [NOAA] 1991).
- The concentration of an inorganic chemical in WET extraction from the soil sample near Seal Creek exceeded the freshwater chronic AWQC
- Chemicals listed as bioaccumulating in fish in the San Francisco Bay (RWQCB 1994)

Table 11-4 presents the ambient and other screening values used in the identification of COECs. Due to the small sample size, any single exceedance was considered significant.

The steps described above were used to identify COECs. Each COEC was further reviewed to evaluate whether (1) adequate information to assess risk was available and (2) frequency of detections and spatial distribution warranted inclusion. The final list of inorganic and organic COECs included in the risk analysis is discussed in Section 11.2.3.

#### **11.2.2.2 Secondary Screening Based on Estimated Ingested Dose**

When information on site concentrations indicated that significant exposure to higher-level receptors may occur, additional screening was conducted that focused on the potential food chain exposure of receptors of concern. This additional screening was conducted only on COECs for which literature values for ecotoxicological effects on relevant species could be found. COECs for which food chain exposure was not assessed were still considered in the overall risk characterization for higher-level receptors, but the uncertainty associated with these chemicals could not be addressed.

Site-specific doses were estimated based on literature derived values of concentrations of chemicals in food. These estimated doses were then compared to toxicity reference values (TRVs) derived from the literature; a hazard quotient approach was used to evaluate potential risk associated with ingestion of site chemicals. This approach is described in more detail in Section 11.3.

### **11.2.3 Nature and Extent of Contamination**

The following sections discuss the analytical results for inorganic and organic chemicals detected at Sites 13 and 17. Figures 5-11 and 6-10 show the sampling locations for each site. Surface and subsurface soil samples were collected at Site 13. Surface soil samples were collected between 0 to 0.5 feet bgs, and subsurface soil samples at depths between 0.5 and 4.0 feet bgs. Surface and subsurface sediment samples were collected from the Seal Creek pipeline discharge area at Site 17.

Sections 11.2.3.1 and 11.2.3.2 present analytical results for organic and inorganic constituents detected at Sites 13 and 17, respectively. Tables 11-2 and 11-3 contain statistical data summaries for Sites 13 and 17, respectively, including summaries of detection limits and comparison of site concentrations with ambient values. The summary tables provide average, minimum, and maximum concentrations; average concentrations were calculated assuming a default value of one-half the sample quantitation limit for results reported as not detected. The following subsections discuss only the detected concentrations of inorganic and organic constituents.

#### **11.2.3.1 Analytical Results for Site 13**

Surface (0 to 0.5 feet bgs) and subsurface (0.5 to 4.0 feet bgs) samples were collected from Site 13 (Figure 5-11). As noted in Section 5.0, soil samples were analyzed for TPH, SVOCs, inorganics, nitrate/nitrite, pH, and percent moisture. Several samples were also analyzed for VOCs (subsurface soil samples only) and geophysical parameters. Limited samples from Site 13 were also analyzed for dioxins. Table 5-2 lists the analyses completed on each sample.

In addition, an extraction test was conducted on 35 randomly selected surface soil samples to estimate the labile (weakly bound) fraction of metals and metalloids. The extraction test used a modified WET method using DI water (WET-DI).

## **Organic Constituents in Soil Samples**

This section presents the concentrations of organic constituents detected in soil samples collected from Site 13. Samples collected at this site were screened against ambient and other screening values shown in Table 11-4. Tables 5-4 to 5-6 summarize the analytical results for organic constituents.

### **Volatile Organic Compounds**

VOCs were analyzed for in 46 subsurface soil samples from Site 13. No VOCs were detected.

### **Dioxins and Furans**

Dioxins and furans were analyzed for in 10 surface soil samples from Site 13. No dioxins or furans were detected.

### **Semivolatile Organic Compounds**

SVOCs were analyzed in 82 surface and subsurface samples from Site 13 (Table 11-2). Ten SVOCs were detected as follows:

#### **PAHs**

- Benzo(a)pyrene was detected in one surface and one subsurface soil samples at concentrations of 70 and 270 µg/kg.
- Three surface and subsurface soil samples contained chrysene at concentrations ranging from 43 to 210 µg/kg.
- Two surface and subsurface soil samples contained fluoranthene at concentrations of 26 and 31 µg/kg.
- Two surface and subsurface soil samples contained pyrene at concentrations of 31 and 250 µg/kg.
- Benzo(b)fluoranthene was detected in one subsurface sample at a concentration of
- 450 µg/kg.

## Other SVOCs

- Eight subsurface soil samples contained phenol at concentrations ranging from 240 to 1,900 µg/kg.
- The compound 2-Chlorophenol was detected in one subsurface soil sample at a concentration of 190 µg/kg.
- The compound 2,4-Dinitrotoluene was detected in one surface sample at a concentration of 120 µg/kg.

## Total Petroleum Hydrocarbons

Petroleum products are a complex mixture of many hundreds of chemicals, some of which are more toxic than others; the volatile aromatic hydrocarbons, such as PAHs, are generally considered the most toxic components. Analyzing samples for TPH is a way of evaluating the extent of contamination; however, risk characterization based on TPH concentration is difficult because no toxicity values for the mixtures are available. Extensive weathering and degradation of petroleum products often reduces the environmental concentration of the more volatile toxic components (ASTM 1995b). Chemical screening and risk characterization related to the motor oil and diesel found at the site thus focused on the PAH and BTEX constituents. The TPH results were used to identify locations that may have significant concentrations of PAHs and BTEX.

TPH was analyzed for in 97 soil samples at Site 13. TPH-diesel was detected in two surface soil samples at concentrations ranging from 15 to 18 mg/kg. A subsurface soil sample from SI trench pit (BUA-13-TP), near the location of the napalm residue, contained TPH-diesel at 5,520 mg/kg.

TPH-motor oil was detected in 25 surface and subsurface soil samples at concentrations ranging from 6.0 to 1,700 mg/kg. The highest concentrations of TPH-motor oil were detected in surface soil samples collected from RI trench pits BUATP041 (1,700 mg/kg), BUATP042 (1,100 mg/kg), and BUATP036 (830 mg/kg) on the western portion of Site 13 near Wake Way.

TPH-diesel and TPH-motor oil were not considered COECs because chemical screening and risk characterization related to TPH focused on PAHs and BTEX constituents.

## **Inorganic Constituents in Soil Samples**

This section presents the concentrations of inorganic constituents detected in soil samples collected from Site 13. All samples collected from Site 13 were considered to be from upland habitat. Inorganic constituents were screened against ambient values. Tables 5-7 and 11-2 summarize the results of the inorganic constituents and compares them to ambient values.

Essential nutrients or minerals such as sodium, potassium, iron, calcium, and magnesium are not national priority pollutants, and so were not screened further. Their effects on vegetative growth are discussed in Section 11.4.

### **Aluminum**

Aluminum was detected in all 98 of the soil samples analyzed for metals ranged from 6,540 to 54,800 mg/kg, with the highest concentration detected in subsurface sample from the RI trench pit BUA-39-TP.

Six soil samples (6.1 percent of the total samples) contained aluminum at concentrations exceeding the ambient concentration (21,000 mg/kg). Aluminum toxicity is strongly correlated with pH and is not usually considered toxic unless soil pH is below 5.5 (Sparling and Lowe 1996). All soil samples collected from Site 13 had pH values greater than 5.5.

Aluminum was not considered a COEC because less than 10 percent of the samples exceeded the ambient concentration.

### **Antimony**

Antimony was detected in 32 of 96 soil samples at concentrations ranging from 0.37 to 84.2 mg/kg. The highest concentrations were detected in surface soil samples from the northern portion of Site 13 in trench pit BUATP024 (84.2 mg/kg) and soil boring BUASB002 (8.4 mg/kg). The subsurface soil sample from the eastern portion of Site 13 in SI trench pit BUA-14-TP also contained one of the highest concentrations of antimony (10.5 mg/kg), although RI samples collected in the same area contained much lower concentrations of antimony (less than 1.5 mg/kg). The ambient concentration of 0.9 mg/kg was exceeded in 10 soil samples (10.4 percent of the total samples).



Antimony was not considered a COEC because only 10 percent of the samples contained antimony at concentrations that exceeded the ambient concentration.

### **Arsenic**

Arsenic was detected in 84 of 98 samples analyzed for inorganics. Concentrations of arsenic in soil samples ranged from 1.7 to 19.4 mg/kg. One of the soil samples collected from Site 13 contained arsenic at concentrations exceeding the ambient concentration of 10 mg/kg.

Arsenic was not considered a COEC because less than 10 percent of the total soil samples exceeded the ambient concentration.

### **Barium**

Barium was detected in all 98 soil samples at concentrations ranging from 63.0 to 18,300 mg/kg. The highest concentrations of barium was detected in subsurface soil sample BUA-39-TP from the RI trench pit. Ten soil samples (10.2 percent) contained barium at concentrations that exceeded the ambient concentration of 560 mg/kg.

Barium was not considered a COEC because slightly more than 10 percent of the samples exceeded the ambient concentration.

### **Beryllium**

Beryllium was detected in 30 of 98 soil samples at concentrations ranging from 0.21 to 0.65 mg/kg. The highest concentration was detected in a subsurface soil sample collected during the RI from trench pit BUASB001. All of the detected concentrations of beryllium (30.6 percent of the total samples) exceeded the ambient concentration of 0.12 mg/kg.

Beryllium was considered a COEC because more than 10 percent of the samples exceeded the ambient concentration.

### **Cadmium**

Cadmium was detected in 17 of the 98 soil samples analyzed for metals. Concentrations ranged from 0.24 to 15.7 mg/kg. The highest concentrations were detected in the surface soil sample from RI soil boring BUATP002 (15.7 mg/kg) near RI trench pit BUATP024; surface soil samples collected from BUATP024 contained much lower concentrations of cadmium (1.7 and 2.1 mg/kg). One subsurface soil sample from SI trench pit BUA-09-TP also contained cadmium at 9.5 mg/kg. Of the 17 cadmium detections, 16 (16.3 percent of the total samples) exceeded the ambient concentration of 0.29 mg/kg.

Cadmium was considered a COEC because more than 10 percent of the samples exceeded the ambient concentration.

### **Chromium**

Chromium was detected in 93 of 98 soil samples at concentrations ranging from 17.3 to 546 mg/kg. The highest concentration of chromium was detected in the subsurface soil sample collected from RI trench pit BUATP027; the maximum concentration of chromium detected in all other samples was 112 mg/kg. Of the 93 chromium detections, eight (8.1 percent of the total samples) exceeded the ambient concentration (62 mg/kg). No hexavalent chromium was detected in the 10 samples in which it was analyzed.

Chromium was not considered a COEC because less than 10 percent of the samples exceeded ambient concentration.

### **Cobalt**

Cobalt was detected in all 98 soil samples at concentrations ranging from 4.5 to 40.5 mg/kg. The highest concentration was detected in the subsurface soil sample collected from RI trench pit BUATP027. Only five soil samples (5.1 percent of the total samples) contained cobalt at concentrations exceeding the ambient concentration of 24 mg/kg.

Cobalt was not considered a COEC because it was detected at concentrations exceeding the ambient concentration in less than 10 percent of the total samples.

### **Copper**

Copper was detected in all 98 soil samples at concentrations ranging from 11.4 to 385 mg/kg. The highest concentrations were detected in surface soil samples from RI trench pit BUA-09-TP and in the surface and subsurface soil samples near RI trench pit BUATP024 and RI soil boring BUATP002. Of the 98 soil samples that contained copper, six (6.1 percent of the total samples) exceeded the ambient concentration of 65 mg/kg.

Copper was detected in less than 10 percent of the samples at concentrations exceeding the ambient concentration. However, copper was considered a COEC because the WET-DI extractions showed that copper concentrations in 42.9 percent of the samples exceeded AWQC for copper.

### **Lead**

Lead was detected in 91 of 98 soil samples collected from Site 13 at concentrations ranging from 4.5 to 5,590 mg/kg. The highest concentration was detected in the surface soil sample from RI trench pit BUATP024; confirmation samples (BUASB011 through BUASB013) collected within a 5-foot radius of this location contained much lower concentrations of lead (24.9, 235, and 25.2 mg/kg). Elevated concentrations of lead were also detected in samples from SI trench pit BUA-09-TP (1,330 mg/kg). Soil samples were collected in this area during the RI (trench pit BUATP038), and lead was detected at concentrations up to 195 mg/kg. Confirmation samples collected from this area (BUATP014 through BUATP016) contained lead at much lower concentrations (up to 36.1 mg/kg). Of the 91 soil samples that contained lead, 14 samples (14.3 percent of the total samples) had concentrations exceeding the ambient level of 33 mg/kg.

Lead was considered a COEC because it was detected in more than 10 percent of the samples at concentrations exceeding the ambient concentration. In addition, the WET-DI extractions showed that lead concentrations in 25.7 percent of the samples exceeded AWQC.

### **Manganese**

Manganese was detected in all 98 soil samples at concentrations ranging from 69.4 to 3,090 mg/kg. The highest concentration was detected in a subsurface soil sample collected from RI trench pit BUATP027.

Seven samples (7.1 percent of the total samples) contained manganese at concentrations exceeding the ambient level of 1,200 mg/kg.

Manganese was not considered a COEC since it exceeded the ambient concentration in less than 10 percent of the samples, and it is not a priority pollutant.

### **Mercury**

Mercury was detected in 48 of 98 soil samples at concentrations ranging from 0.06 to 0.37 mg/kg. Seven soil samples (7.1 percent of the total samples) contained mercury at concentrations exceeding the ambient concentration (0.17 mg/kg).

Mercury was detected in less than 10 percent of the samples at concentrations exceeding the ambient concentration. However, it was considered a COEC because the WET-DI extractions showed that mercury concentrations in 40.0 percent of the samples exceeded AWQC. In addition, mercury shows the potential for bioaccumulation and trophic transfer (Suedel and Others 1994).

### **Molybdenum**

Molybdenum was not detected in any soil samples nor during sampling to determine ambient concentrations. Molybdenum was not considered a COEC.

### **Nickel**

Nickel was detected in 97 of 98 soil samples at concentrations ranging from 14.3 to 361 mg/kg. The highest concentration was detected in the subsurface soil sample collected from RI trench pit BUATP027. Four soil samples (4.1 percent of the total samples) contained nickel at concentrations exceeding the ambient level (100 mg/kg).

Nickel was not considered a COEC because it was detected at concentrations exceeding the ambient level in less than 10 percent of the total samples.

### **Selenium**

Selenium was not detected in any soil samples. An ambient concentration is not available for selenium. Selenium was not considered a COEC.

### **Silver**

Silver was detected in 4 of 98 soil samples (4.1 percent of the total samples) at concentrations ranging from 0.12 to 1.6 mg/kg. The highest concentration of silver was detected in a surface soil sample collected from RI trench pit BUASB002. An ambient concentration is not available for silver.

Silver was not considered a COEC because it was detected in less than 10 percent of the soil samples.

### **Thallium**

Thallium was detected in 9 of 98 soil samples at concentrations ranging from 0.39 to 2.5 mg/kg. Only one surface soil sample from RI trench pit BUATP024 contained thallium at a concentration exceeding the ambient concentration of 1.9 mg/kg.

Thallium was not considered a COEC because it was detected in only one sample at a concentration exceeding the ambient concentration.

### **Vanadium**

Vanadium was detected in all 98 soil samples at concentrations ranging from 15.6 to 131 mg/kg. One subsurface soil sample from RI trench pit BUATP027 (112 mg/kg) and another subsurface soil sample from RI trench pit BUASBF02 (2.0 percent of the total samples) contained vanadium at concentrations exceeding the ambient concentration of 96 mg/kg.

Vanadium was not considered a COEC because it was detected in less than 10 percent of the samples at concentrations exceeding estimated the ambient concentration.

## **Zinc**

Zinc was detected in 93 of 98 soil samples collected at concentrations ranging from 13.4 to 4,570 mg/kg. The highest concentrations were found in surface soil samples collected from RI trench pit BUATP024 (4,570 mg/kg), RI soil boring BUASB002 (1,340 mg/kg), and SI trench pit BUA-09-TP (1,580 mg/kg). Concentrations of zinc in 16 soil samples (16.3 percent of the total samples) exceeded the ambient concentration (99 mg/kg).

Zinc was considered a COEC because it was detected in more than 10 percent of the samples at concentrations exceeding the ambient concentration. In addition, the WET-DI extractions showed that zinc concentrations in 20.0 percent of the samples exceeded AWQC levels.

## **Results of WET-DI**

Thirty-five surface samples were analyzed using the WET aqueous extraction method for metals in the RI. In general, metals showed limited tendency to desorb from soil particles in a simple aqueous extraction; that is, chemicals occur at relatively low concentrations in WET aqueous extractions compared to bulk soils. WET metal concentrations were generally two to three orders of magnitude less than total metal concentrations in bulk soils. Also, the number of nondetects in WET results was frequently greater than 20 percent, and in some cases greater than 50 percent (for example lead), suggesting that little, if any, desorption had occurred in the aqueous extraction process. Levels of aqueous solubility are comparable to the weakly acidic extractions of soils completed as part of the comprehensive soil analysis (see Section 11.4).

Copper, lead, mercury, and zinc are considered COECs due to WET extractions exceeding the AWQC used as screening criteria at the Burn Area. Table 11-5 summarizes statistics for metals found at Site 13

## **Summary of COECs in Soil**

No organic constituents, except TPH-motor oil, was detected in greater than 10 percent of the samples; none were considered COECs. Motor oil was not considered a COEC because the persistent toxic constituents of motor oil (PAHs) were evaluated separately.

The following inorganic chemicals were considered COECs for the Burn Area based on exceedance of either ambient value or freshwater chronic AWQC:

<b>Chemical</b>	<b>Ambient Exceeded</b> (percent samples detected)	<b>AWQC Exceeded</b> (percent samples detected)
Beryllium	30.6	< 10.0
Cadmium	16.3	< 10.0
Copper	< 10.0	42.9
Lead	14.3	25.7
Mercury	< 10.0	40.0
Zinc	16.3	20.0

#### **11.2.3.2 Analytical Results for Site 17**

The habitat of ecological concern at Site 17 is centered on the sediment and banks of Seal Creek. Three surface (0 to 0.5 feet bgs) and one subsurface (2.5 to 3.0 feet bgs) sediment samples were collected in the stream bed of Seal Creek near the discharge pipe. Two soil samples (one surface, one subsurface) were collected at a single location below the former steam cleaning outfall on the bank of Seal Creek. As noted in Section 6.0, the samples were analyzed for TPH, SVOCs, VOCs, metals, pH, and percent moisture. In addition, a WET-DI extraction test was conducted on several samples to estimate the labile (weakly bound) fractions of metals and metalloids. Table 6-2 lists the analyses performed on each sample.

#### **Organic Constituents in Soil and Sediment Samples**

This section presents the concentrations of organic constituents detected in sediment samples collected from the stream bed and the single soil sample collected from the bank of Seal Creek at Site 17. Samples collected from Site 17 were screened against ambient and other screening values shown in Table 11-4. Tables 6-4 to 6-6 summarize the analytical results for organic constituents.

### **Volatile and Semivolatile Organic Compounds**

No VOCs or SVOCs were detected in the sediment and soil samples taken in the stream bed and bank of Seal Creek at Site 17.

### **Total Petroleum Hydrocarbons**

Petroleum hydrocarbons were analyzed in 30 soil and sediment samples at Site 17, and only TPH-motor oil was detected in surface and subsurface samples. TPH-motor oil detected in four sediment samples from the stream bed of Seal Creek had concentrations ranging from 110 to 4,100 mg/kg. One surface soil sample and one subsurface soil sample, collected at location ACSSB028 on the bank of Seal Creek, contained TPH-motor oil concentrations of 120 and 75 mg/kg, respectively.

TPH-diesel and TPH-motor oil were not considered COECs because chemical screening and risk characterization related to TPH focused on PAHs and BTEX constituents.

### **Inorganic Constituents in Soil and Sediment Samples**

This section presents the concentrations of inorganic constituents detected in soil and sediment samples collected from Site 17. Tables 6-7 and 11-3 summarize the results of inorganic constituents and compares them to ambient and ER-M values shown in Table 11-4.

#### **Aluminum**

Aluminum was detected in all six samples collected from the stream bed and bank of Seal Creek at concentrations ranging from 11,400 to 18,100 mg/kg. The highest concentration was detected in a 2.5 to 3 feet bgs soil sample from the stream bank of Seal Creek. Aluminum is not considered a COEC at Site 17 because none of the samples exceeded the ambient concentration (20,000 mg/kg).

#### **Antimony**

Antimony is not considered a COEC at Site 17 because it was not detected in the samples collected from the stream bed and bank of Seal Creek.



### **Arsenic**

Arsenic was detected in all six samples collected from the stream bed and bank of Seal Creek at concentrations ranging from 1.10 to 5.70 mg/kg. The highest concentration was detected in a 0 to 0.5 feet bgs sediment sample from the stream bed of Seal Creek. Arsenic is not considered a COEC at Site 17 because none of the samples exceeded the ambient concentration (7.3 mg/kg).

### **Barium**

Barium was detected in all six samples collected from the stream bed and bank of Seal Creek at concentrations ranging from 62 to 153 mg/kg. The highest concentration was detected in a 0 to 0.5 feet bgs sediment sample from the stream bed of Seal Creek. Barium is not considered a COEC at Site 17 because none of the samples exceeded the ambient concentration (210 mg/kg).

### **Beryllium**

Beryllium was detected in all six samples collected from the stream bed and bank of Seal Creek at concentrations ranging from 0.13 to 0.40 mg/kg. The highest concentration was detected in a 0 to 0.5 feet bgs sediment sample from the stream bed of Seal Creek. Beryllium is not considered a COEC at Site 17 because none of the samples exceeded the ambient concentration (0.56 mg/kg).

### **Cadmium**

Cadmium was detected in one soil sample taken from the stream bank of Seal Creek at a concentration of 0.35 mg/kg. Although the cadmium concentration in this sample exceeded the ambient level (0.15 mg/kg), it did not exceed the ER-L (1.2 mg/kg). Cadmium is not considered a COEC at Site 17.

### **Chromium**

Chromium was detected in all six samples collected from the stream bed and bank of Seal Creek at concentrations ranging from 30.3 to 58.6 mg/kg. The highest concentration was detected in a 2.5 to 3 feet bgs soil sample from the stream bank of Seal Creek. Although the chromium concentration in this sample exceeded the ambient level (55 mg/kg), it did not exceed either the ER-L (81 mg/kg) or the ER-M (370 mg/kg) concentrations. Chromium is not considered a COEC at Site 17.

### **Cobalt**

Cobalt was detected in all six samples collected from the stream bed and bank of Seal Creek at concentrations ranging from 13.8 to 20.6 mg/kg. The highest concentration was detected in a 2.5 to 3 feet bgs soil sample from the stream bank of Seal Creek. Because none of the samples exceeded the ambient concentration (24 mg/kg), cobalt is not considered a COEC at Site 17.

### **Copper**

Copper was detected in all six samples collected from the stream bed and bank of Seal Creek at concentrations ranging from 31.8 to 87.7 mg/kg. The highest concentration, detected in a 2.5 to 3 feet bgs soil sample from the stream bank near this sample location of Seal Creek, exceeded the ambient level (64 mg/kg) as well as the ER-L (34 mg/kg) concentration. Should the stream bank erode and the contaminated soil be deposited into the stream bed, the soil is expected to be sufficiently dispersed so that the concentrations do not pose a significant risk to aquatic receptors. Therefore, copper is not considered a COEC at Site 17.

### **Lead**

Lead was detected in all six samples taken from the stream bed and bank of Seal Creek at concentrations ranging from 9.30 to 16.50 mg/kg. The highest concentration was detected in a 2.5 to 3 feet bgs soil sample from the bank of the creek. Because the lead in this sample does not exceed the ambient level (18 mg/kg), lead is not a COEC at Site 17.

### **Manganese**

Manganese was detected in all six samples collected from the stream bed and bank of Seal Creek at concentrations ranging from 388 to 753 mg/kg. The highest concentration was detected in a 2.5 to 3 feet bgs soil sample from the bank of the creek. Because none of the samples exceeded the ambient concentration (870 mg/kg), manganese is not a COEC at Site 17.

### **Mercury**

Mercury is not considered a COEC at Site 17 because it was not detected in samples collected from the stream bed and bank of Seal Creek.

### **Molybdenum**

Molybdenum was detected in a 2.5 to 3 feet bgs soil sample taken from the bank of Seal Creek at a concentration of 1.80 mg/kg. It was also detected in a 3 to 3.5 feet bgs sediment sample taken from the stream bed of the creek at a concentration of 1.10 mg/kg. Molybdenum is not considered a COEC at Site 17 because the concentrations in these samples did not exceed the ambient molybdenum level (detection limit  $\geq 380$  mg/kg).

### **Nickel**

Nickel was detected in all six samples taken from the stream bed and bank of Seal Creek at concentrations ranging from 48.7 to 101 mg/kg. The highest concentration was detected in a 2.5 to 3 feet bgs soil sample from the stream bank of Seal Creek. The nickel in this sample exceeded the ambient (86 mg/kg), ER-L (20.9 mg/kg), and ER-M (51.6 mg/kg) concentrations. Should the stream bank erode and the contaminated soil be deposited into the stream bed, the soil is expected to be dispersed. This concentration of nickel is not sufficiently elevated to warrant concern. As a result, nickel is not a COEC at Site 17.

### **Silver**

Silver is not considered a COEC at Site 17 because it was not detected in the samples collected from the stream bed and bank of Seal Creek.

### **Thallium**

Thallium was detected in all six samples collected from the stream bed and bank of Seal Creek in concentrations ranging from 0.14 to 0.23 mg/kg. The highest concentration was detected in a 2.5 to 3 feet bgs soil sample from the bank of the creek. Thallium is not considered a COEC at Site 17 because the thallium concentration in this sample does not exceed the ambient level.

### **Vanadium**

Vanadium was detected in all six samples collected from the stream bed and bank of Seal Creek in concentrations ranging from 47.6 to 98.7 mg/kg. The highest concentration, detected in a 2.5 to 3 feet bgs soil sample from the bank of the creek, exceeded ambient levels (86 mg/kg) of vanadium very slightly. No ER-Ls or ER-Ms were available to assess the biological effects potentially caused by this concentration of vanadium. However, this level of vanadium is near enough to ambient concentrations to be considered within background limits. Vanadium is not a COEC at Site 17.

### **Zinc**

Zinc was detected in all six samples collected from the stream bed and bank of Seal Creek at concentrations ranging from 63.7 to 125 mg/kg. The highest concentration, found in a 0 to 0.5 feet bgs soil sample from the bank of Seal Creek, exceeded the ambient level (83 mg/kg). However, zinc is not considered a COEC at Site 17 because this zinc concentration did not exceed the ER-L (150 mg/kg) or the ER-M (410 mg/kg) concentrations.

### **WET-DI Results**

Three surface sediment samples and one surface soil sample from the stream bed and bank of Seal Creek were analyzed using the WET-DI extraction method for inorganics in the overall RI. For the sediment samples, only extracted concentrations of zinc exceeded the fresh water AWQC used as screening criteria at Site 17. For the soil sample, copper, iron, lead, mercury, silver, and zinc exceeded the fresh water AWQC. Table 11-6 summarizes the measured WET metal concentrations at Site 17 and includes AWQC screening values for comparison. Because ambient concentrations in soil were not exceeded, none of these chemicals were considered COECs.

### **Summary of COECs at Site 17**

No sediment samples taken from Seal Creek had constituent concentrations that exceeded ambient levels. Although the concentrations in one soil sample taken from the bank of Seal Creek exceeded the ambient, ER-L, and ER-M levels of some constituents, no exceedance was large enough to warrant concern. As a result, none of these inorganic constituents were considered COECs at Site 17.

#### **11.2.4 Ecological Characterization**

Ecological characterization involves identifying ecological receptors (plants and animals) that may be at risk at the site. Qualitative characterization of habitats and receptors at the Inland Area of NWS was included in the initial assessment study report (E&E 1983), the SI report (PRC/Montgomery Watson 1993a), "A Natural Resources Survey Naval Weapons Station Concord, California" (Jones & Stokes Associates [Jones & Stokes] 1982), and a "Wildlife Survey of Concord Naval Weapons Station" conducted in 1994 by the University of California Berkeley (UCB). In addition, site surveys were conducted by PRC staff ecologists (G. Linder, M. Gleason, and J. Mire). These assessments describe the nature and composition of aquatic and terrestrial plant and animal communities within the study area. Characterizations of Site 13 consisted of the following study elements:

- Describing the nature and composition of the plant and animal communities in the study area
- Evaluating the potential habitat value of terrestrial and aquatic communities
- Conducting observations of wildlife species, their habitats, and key food organisms within the study area
- Compiling basic information on federal or state rare, threatened, or endangered species within the study area
- Recording indicators of stress to vegetational communities and suggesting possible physical, biological, or climatic stressors

The following sections describe the typical habitats of Site 13, and present hypothetical food webs used to develop the conceptual site model for the site. The conceptual site model and selection of assessment and measurement endpoints for Site 13 follows in Section 11.2.5.

##### **11.2.4.1 Typical Habitat of Burn Area (Site 13)**

The Burn Area is relatively small and lacks unique habitat features to set it apart from the disturbed grassland habitat in which it is located. Site visits and reviews of photographic records yielded the following generalizations about the Burn Area:

- The Burn Area is a highly disturbed, steeply sloped pasture, with the soil surface and vegetation clearly indicating the site has been chronically overgrazed.

- The vegetation during the dry season appears to be of low diversity, dominated by invasive weedy species, especially exotic grasses and forbs.
- The relatively steep slopes are not heavily eroded; gully erosion in the former trench area may be a residual sign of past waste management activities.
- Terrestrial wildlife casually observed included spoor of resident small mammals and large canids, raptor regurgitation pellets with cricetine bone fragments, and raptors in soaring flight.

In conjunction with existing information, including soil surveys available for the site from the Contra Costa County Natural Resource Conservation Service, these field observations were integrated into the evaluation of exposure pathways and risk characterization (see Section 11.5).

### **Vegetation**

In a natural resources survey of the Inland Area, Jones & Stokes (1982) characterized soils as hard-packed, dry, and relatively infertile. Soil invertebrates and plant diversity are both relatively low. Non-native grasses and forbs such as thistles and filaree dominate the landscape; vegetation structure and composition are similar to that of disturbed valley and foothill grasslands. Most of the grasslands are grazed by cattle, and steep slopes and high ridges comprise the majority of the least disturbed grassland areas. Soils and vegetation, including a discussion of soils analysis, are considered further in Section 11.5, Risk Characterization.

### **Terrestrial Fauna**

Grassland habitat at Site 13 supports insects and terrestrial vertebrates including reptiles, birds, and small and large mammals. Upland areas are host to an abundant population of deer mice, house mice, and the California vole. Ungrazed areas support small populations of western harvest mice. Trapping success rates in upland areas of NWS Concord indicated that small mammal populations in the disturbed grassland habitat are low (Jones and Stokes 1982; PRC 1996d). According to the survey results conducted by the UCB in 1994, red fox and coyote are prevalent in the grasslands of NWS Concord and may hunt at Site 13. Great-horned owl and several diurnal raptors were also observed at Site 13, including the sharp-shinned hawk, red-tailed hawk, and merlin.

## **Special Status Receptors**

Special status species are plants and animals that are legally protected under the state and federal endangered species acts or other regulations, and species that are considered rare by the scientific community. Special status species are defined as:

- Plants and animals that are listed or proposed for listing as threatened or endangered under the California Endangered Species Act and the Federal Endangered Species Act
- Plants and animals that are designated special species of concern by the federal government
- Plants and animals that meet the definition of rare or endangered under the California Environmental Quality Act which may include species not necessarily found on state or federal endangered species lists
- Plants occurring on lists 1A, 1B, 2, 3, and 4 of the California Native Plant Society's (CNPS) Inventory of Rare and Endangered Vascular Plants of California (Smith and Berg 1988); the California Department of Fish and Game (CDFG) recognizes that lists 1A, 1B, and 2 of the CNPS inventory contain plants that, in the majority of cases, would qualify for state listing, and CDFG requests their inclusion in environmental impact reports as necessary. Plants occurring on CNPS lists 3 and 4 are "plants about which more information is necessary," and "plants of limited distribution," respectively (Smith and Berg 1988), and may be included as special status species on the basis of local significance and/or recent biological information
- Animals that are designated as "Species of Special Concern" by CDFG (1994)
- Animals that are designated "Species of Concern" by USFWS
- Animal species that are "fully protected" in California by the Fish and Game Code

The following sections identify special status species plants and animals expected or observed at the Inland Area sites based on the above reports. The special status species lists were compiled from the literature and information from the California Department of Fish and Game, the Natural Heritage Division, the California Native Plant Society East Bay Chapter, and the Nature Conservancy.

## **Special Status Plants**

The Natural Heritage Division provided information on the U.S. Geological Survey (USGS) 7.5-minute quadrangle maps for Walnut Creek, Vine Hill, and Clayton, California. This information was used to access the appropriate sections of the California Native Plant Society's Inventory of Rare and

Endangered Vascular Plants of California (Skinner 1994), and indicates that rare, threatened, and endangered plant species have been reported geographically at or near NWS Concord Inland Site 13.

PRC reviewed the following literature, suggested by the California Native Plant Society East Bay Chapter:

- The Jepson Manual: Higher Plants of California (Hickman 1993)
- Unusual and Significant Plants of Alameda and Contra Costa Counties (Lake 1995)
- Status of Rare, Threatened and Endangered Vascular Plants in Alameda and Contra Costa Counties (and some adjacent areas) (Olson 1994)
- California Native Plant Society's Inventory of Rare and Endangered Vascular Plants of California (Skinner 1994)

As part of the RI, a rare, threatened, and endangered plant survey was conducted at Site 13. No protected plant species were observed on site. The UCB wildlife survey conducted in 1994 also states that no protected plant species were observed in the grasslands of NWS Concord.

#### **Special Status Animals**

No special status animals have been observed or reported at Site 13. However, based on data compiled from the California Natural Diversity Data Base (1994) records for the Vine Hill, Honker Bay, Benicia, Briones Valley, Walnut Creek, Clayton, Cordelia, Fairfield South and Denverton quadrangles, the CNPS Inventory (Smith and Berg 1988), and the UCB Wildlife Survey of Concord Naval Weapons Station, the following special status species could occur:

- California legless lizard, *Anniella pulchra pulchra* (state species of special concern)
- American peregrine falcon, *Falco peregrinus anatum* (federal and state endangered)
- Golden eagle, *Aquila chrysaetos* (state species of special concern)
- White-tailed kite, *Elanus leucurus* (Contra Costa County unique wildlife)
- Bald eagle, *Haliaeetus leucocephalus* (federal and state endangered)
- Grasshopper sparrow, *Ammodramus savannarum* (Contra Costa County unique wildlife)



#### 11.2.4.2 Food Web - Burn Area

Figure 11-1 illustrates the food webs at the Burn Area. Addressing numerous trophic levels is important in assessing ecological risk, especially if the chemicals have the potential to bioaccumulate. Decaying organic matter (DOM) and primary producers establish the foundation of the terrestrial food web; terrestrial detritivores and omnivores such as insects, oligochaetes, and other arthropods consume DOM and plants. Terrestrial vertebrates such as the northwestern fence lizard, California quail, and western harvest mouse, feed on the primary producers and detritivores/omnivores and in turn become prey for higher trophic level species. Top predators of the food web include raptors such as the red-tailed hawk, as well as carnivorous mammals such as coyote.

For the Burn Area, representative receptors evaluated in food chain analysis included:

- California quail (*Callipepla californica*)
- Western harvest mouse (*Reithrodontomys megalotis*)
- Red-tailed hawk (*Buteo jamaicensis*)
- Coyote (*Canis latrans*)

The California quail is an upland gallinaceous game species common to the grassy fields of the San Francisco Bay area; they have been observed in the Inland Area of NWS Concord. Quail forage on the ground, consuming buds, seeds, berries, and insects. They were selected as a representative species because (1) they are year-round residents in the area, (2) their natural history is well known, and (3) sufficient toxicological data are available for risk assessment.

Small mammals are critical components of an upland food web. The western harvest mouse is representative of small herbivorous mammals common to grasslands such as those at the Burn Area. The western harvest mouse is a nocturnal fruit and seed-eating cricetine rodent, preferring wild plants over agricultural cultivars. In addition, western harvest mice consume insects (mostly grasshoppers), particularly during summer months. Habitat preferences are primarily arid uplands dominated by grassy and weedy vegetation. Within these habitats they are one of the most numerous vertebrates when habitats are adequate to maintain their populations. Common predators include owls, hawks, jays, coyotes, and badgers. In warmer areas of their range such as at NWS Concord, breeding occurs year

round, although a respite is generally observed during the hotter periods of the year. Fecundity is impressive, which accounts for the high populations generally encountered in grassy and weedy uplands. Life span is relatively short. Most field studies clearly indicate that an entire population is replaced by the succeeding generation every year.

A predator frequently observed at the Inland Area, the red-tailed hawk is common throughout much of the western United States. Red-tailed hawks are birds of both open fields and woodland areas, particularly at woodland edges. Their primary prey are rodents, but they may also take insects and larger mammals (including squirrels and rabbits), as well as carrion.

As a predator, the coyote is a representative species in the food-chain analysis for the Burn Area. Coyotes are ubiquitous throughout the western United States, and are the top predator in most terrestrial food chains in habitats like those at the Burn Area. Their chief food sources are ground-dwelling rodents, including microtine and cricetine rodents like the western harvest mouse. Coyotes have been observed in the Inland Area.

#### **11.2.5 Conceptual Site Model - Burn Area**

This section describes the conceptual site models for Site 13, including exposure pathways, fate and transport of chemicals, and selection of assessment and measurement endpoints.

The route by which a chemical enters an organism is a critical element in the risk analysis. Other factors that influence its risk include the toxic properties of the chemical, site conditions, and the natural history of the target organisms. Exposure can be influenced by variables such as seasonal activities, habitat preference, and feeding behavior of a receptor, as well as spatial variation in chemical distribution. Hence, characteristics of life history as well as COECs themselves were critical to developing a conceptual site model for the Burn Area.

#### **11.2.5.1 Chemical Stressors in the Upland Habitat**

Data from soil samples in the upland habitat were presented in Sections 5.0 and 6.0, and summarized in Section 11.2. A variety of inorganic chemicals were found in the upland habitat; the list of COECs was included in Section 11.2. No organic COECs were identified.

The upland habitat at Site 13 is characterized by introduced grasses and relatively poor soil fertility. Historical and current grazing in the area and disturbance due to other past site use should be considered additional stressors that confound the interpretation of effects of chemical stressors.

#### **11.2.5.2 Exposure Pathways and Critical Receptors**

Complete exposure pathways for the upland habitats were identified based on species composition and COECs and on conversations with regulatory agencies and natural resource trustees. Ingestion of contaminated prey and media is considered to be the predominant exposure pathway at Site 13.

Many species ingest soil as a result of feeding, grooming, burrowing, and other activities (Beyer and others 1994). Detritivores, such as insects and earthworms, ingest contaminated soil and detritus in the process of feeding. Uptake of chemicals by plants may cause direct effects on the plants as well as on the herbivores, such as small mammals and granivorous birds, that consume them. Many raptors and mammalian carnivores ingest soil on the coats and in the guts of their prey. Bioaccumulation may expose predators to unacceptably high levels of chemicals even when concentrations in soil or sediment are not considered toxic to species at lower trophic levels.

#### **11.2.5.3 Fate and Transport**

Potential pathways for chemical mobilization and transport include:

- Surface transport including advective transport of chemicals dissolved in surface water or absorbed to suspended sediments and wind-driven transport of soil particles
- Biotic transport such as movement of chemicals in tissues of plants or animals at the site

These transport pathways and the potential for migration of site chemicals are discussed in the following sections.

The main mechanism of surface transport of chemicals at site 13 is via surface water movement, particularly runoff during and after rain events. Surface water runoff can transport suspended sediments with adsorbed chemicals to other areas of the upland habitat or to receiving waters. Wind transport of contaminated soil is potentially important in the drier upland habitats at the site during the dry season. Chemicals may also be transported in plant and animal tissues. Chemicals in the bodies of mobile receptors such as migrating birds, flying insects, and far-ranging predators may be carried off site and deposited in other locations in the form of feces or corpses.

#### **11.2.5.4 Assessment and Measurement Endpoints**

According to EPA (1989a), assessment endpoints are environmental characteristics or values which, if found to be significantly affected, would indicate a need for remedial action. Measurement endpoints attempt to more directly identify adverse potential effects on the assessment endpoints. Measurement endpoints include biological assessments, such as laboratory toxicity tests, and derived estimates of risks based on modeled exposure parameters like those from linear food-chain analysis.

##### **Assessment Endpoints**

Assessment endpoints focused on habitats as well as the species that rely on these habitats, as follows:

- Maintenance of grassland vegetation typical of the area
- Protection of the terrestrial animal community typical of disturbed grassland habitat of the area
- Protection of surface waters receiving runoff from the site (ultimately Suisun Bay)

##### **Measurement Endpoints - Burn Area**

Risk assessment efforts at the Inland Area focused on species-level evaluations of risk. In the absence of clearly established regulatory criteria for COECs in soil, measurement endpoints focused on food-chain evaluations when data were available. Food-chain analysis yielded COEC-specific doses for selected

receptors. The food-chain model estimated chemical exposures to higher trophic level birds and mammals from measurements of chemical concentrations in environmental media.

Food-chain modeling is one way of integrating ecological information into the risk assessment process for chemicals that present a hazard associated with long-term, less-than-acutely toxic exposures (for example, chemicals that bioconcentrate or bioaccumulate).

Measurement endpoints included the following:

- Daily dose estimates for comparison to toxicity reference values for selected species (California quail, red-tailed hawk, western harvest mouse, and coyote)
- Ambient concentrations of chemicals in soil
- Microbial, soil, and nutrient analysis
- Microtox
- WET extractions compared to AWQC

Risk to assessment and measurement endpoints was evaluated based on the following criteria: (1) exceedance of ambient values for soils, (2) exceedance of AWQC in WET extractions, and (3) effects assessment comparing site-specific doses to toxicity reference values. The relationship between measurement and assessment endpoints is presented below:

Assessment Endpoint	Measurement Endpoint
<ul style="list-style-type: none"><li>• Maintenance of grassland vegetation typical of the area</li></ul>	<ul style="list-style-type: none"><li>• Ambient concentrations of chemicals in soil</li><li>• Microbial, comprehensive soil and nutrient analysis, Microtox</li></ul>
<ul style="list-style-type: none"><li>• Protection of the terrestrial animal community typical of disturbed grassland habitat of the area</li></ul>	<ul style="list-style-type: none"><li>• Ambient concentrations of chemicals in soil</li><li>• Daily dose estimates for comparison to toxicity reference values for selected species</li></ul>
<ul style="list-style-type: none"><li>• Protection of surface waters receiving runoff from the site</li></ul>	<ul style="list-style-type: none"><li>• Ambient concentrations of chemicals in soil</li><li>• WET extractions compared to AWQC</li></ul>

### **11.3 EXPOSURE ASSESSMENT**

Exposure of receptors to chemicals at Site 13 was evaluated using the following data:

- Site visits and literature reviews to identify the important receptors and complete exposure pathways at the site
- Evaluation of soil parameters affecting bioavailability of chemicals to receptors
- Food chain modeling to estimate potential ingested doses for selected higher level receptors

Vertebrate receptors identified in the conceptual site model include the California quail, western harvest mouse, red-tailed hawk, and coyote. For most chemicals, risk to these receptors was evaluated using food chain models that incorporated estimates of chemical concentrations in prey based on exposure assumptions and biomagnification factors obtained from the literature. Section 11.3.3 describes the models and assumptions used to calculate doses for these receptors.

#### **11.3.1 Complete Exposure Pathways**

Representative mammals (western harvest mouse and coyote) and birds (California quail and red-tailed hawk) are expected to be exposed to chemicals in soil through incidental ingestion as well as through ingestion of contaminated prey. Digging in soil and grooming may result in ingestion of soil and associated chemicals. Ingestion of soil and prey were considered the primary routes of exposure. Dermal exposure was not considered in the risk assessment, as this route is expected to be much less significant for the receptors of interest. In addition, methods of assessing exposure and effects to avian and mammalian receptors due to dermal contact with upland soils are not well developed. No surface water exists at the site, so this source was excluded from the exposure assessment.

#### **11.3.2 Measures of Bioavailability**

Total metals measured in bulk soils may not represent exposure conditions in the rhizosphere (Linder and others 1994a). Therefore, analytical tools such as (1) comprehensive soil analysis, (2) WET aqueous extractions, and (3) Microtox analyses were used at Site 13 to assess the soluble fraction of the chemical. Each of these tools is discussed briefly below.

### 11.3.2.1 Comprehensive Soil Analysis

Evaluation of various soil parameters including pH, cation exchange capacity, and total organic carbon are included in this section to estimate bioavailability under existing site conditions. Specific results of the comprehensive soil analysis at the Burn Area are presented in Section 11.4. Parameters are discussed generally below.

Exposure of ecological receptors to chemicals in soil is in part determined by geochemical properties of soils such as pH, particle size distribution, and concentration of trace nutrients. When rainfall exceeds evapotranspiration, as at Site 13, soils are leached. Leaching gradually removes soluble salts from the soil, resulting in acidic conditions. Soil acidity and alkalinity as well as physical structure play important roles in exposure potential. For example, soil pH greatly affects the concentration of inorganic ions in soil solution. Some metals, including trace nutrients such as iron, manganese, and zinc, adsorb almost completely to the soil matrix at a pH between 5.5 and 8 (Kabata-Pendias and Pendias 1992).

Soils at the Burn Area varied between a pH of 5.5 to 6.8 (see Table 11-7). Plants that use nitrogen in the form of ammonium tend to have an advantage in acidic soils, since leached soils tend to be nitrate-nitrogen deficient and microbial oxidation of ammonium to nitrate is relatively slow at pH 5.5. Similarly, the availability of soil phosphate is highly dependent upon soil pH. Under acidic conditions, soil phosphate becomes less available to plants because of its precipitation as iron and aluminum phosphates. In contrast to nitrogen and phosphate, soil potassium availability in acidic soils is highly variable, and potassium levels are often in marked contrast to the trends seen for nitrogen and phosphate. This variability stems in part from the influence of other soil characteristics (for example, cation exchange capacity and the concentration of complementary ions) on potassium availability. For example, potassium ions are less likely to leach from soils high in calcium, but are more likely to be displaced and leached from soils high in aluminum.

Information on specific sample locations and their analytical results appears in Section 5.0. Appendix J contains analytical results from samples collected at the Burn Area during the RI.

#### **11.3.2.2 Waste Extraction Test**

WET-DI results appear in Tables 11-5 and 11-6. WET results indicate leachable concentrations of metals at least an order of magnitude less than those measured in bulk soil samples. Additionally, and although not directly comparable, the weakly acidic extractions completed as part of the comprehensive soil analysis are consistent with WET-DI. Both tests indicate that metal concentrations in soils extracts are two to four orders of magnitude less than those measured in bulk soils. These results are consistent with other observations seen across a variety of soil types (Linder and others 1994a), which indicate that total metals measured in bulk soils do not represent the concentrations characteristic of exposure conditions in the rhizosphere or indirectly to biota exposed to soils and plants at ground surface. Weakly acidic extractions of soil, however, may more closely estimate bioavailability of inorganics in the rhizosphere. Quite frequently, metals in DI extractions occurred at levels approaching the analytical detection limit, an observation that reinforces the conclusion that elemental availability in soils at the Burn Area is relatively limited.

Table 11-5 contains summary descriptive statistics for soil samples and WET results. Statistical analyses reported in Table 11-5 were conducted using two independent statistical analysis packages, StatMost and GeoEAS. The former is a parametric and nonparametric statistical analysis tool; the latter is a spatial statistics and distribution analysis package capable of providing summary descriptive statistics. For the ERA at the Burn Area, the focus of data reduction and data analysis was the subset of RI samples collected as part of the field investigations supporting the site-specific evaluation of ecological risks. Summary statistics and distribution tests were routinely completed for this subset of soil samples (see Section 11.4).

#### **11.3.2.3 Microtox**

Biological assessments with Microtox are presented in Table 11-7, and are summarized in Section 11.4, Ecological Effects Assessment. The Microtox bioassay provides a measure of the bioavailability of inorganic chemicals in soil. Results indicated only limited bioavailability of inorganic chemicals in soils at Site 13.



### **11.3.3 Food Chain Modeling Approach Using Estimates of Prey Concentrations**

A third line of evidence of exposure to chemicals at site 13 is the estimation of daily doses ingested by selected receptors. The food chain model used to estimate doses incorporated an estimate of chemical concentrations in food items from biomagnification factors or other estimates derived from the literature.

Food chain models assess the exposure of higher level receptors to chemicals in their diet. These models are conceptually simple and focus on ecological receptors of concern. Food chain models are one method of integrating ecological and chemical information into the risk assessment process, especially for chemicals that tend to bioconcentrate or bioaccumulate (Pascoe and others 1996).

This section describes the model that was used to estimate risk from site chemicals to higher level mammalian and avian receptors using estimated prey concentrations. Exposure models for birds and mammals are based on the assumption that exposure to chemicals is primarily through ingestion of contaminated soil and prey. Surface water ingestion, dermal contact, and inhalation are other possible routes of exposure not evaluated in these models. The exposure models estimate the mass of a chemical internalized daily by a receptor per kilogram of body weight (daily chemical dosage). Estimates of exposure are generally based on knowledge of the spatial and temporal distribution of both chemicals and receptors, and on specific natural and life history characteristics that influence exposure to chemicals. Site-specific data on chemical concentrations in soil and prey are used in conjunction with available literature values for other parameters to estimate daily dose.

#### **11.3.3.1 Natural History Parameters Affecting Exposure**

As discussed previously, several life and natural history characteristics of receptors influence exposure to contamination and must be incorporated into the exposure model for an assessment receptor. These characteristics include diet composition, ingestion and metabolic rates, body weight, foraging range, seasonal presence at the site, feeding behavior, reproductive behavior, and others. For each receptor, information on relevant life and natural history characteristics influencing exposure and risk was collected from the literature and used in the dose model and risk characterization. When available, data from the San Francisco Bay region and California were preferred over data from other locations. From

these data, specific values for each parameter were selected for use in calculating the receptor's dose (Table 11-8).

#### **11.3.3.2 Temporal and Spatial Characteristics of Exposure**

Seasonal activities, habitat preference, and the feeding behavior of a receptor, as well as spatial variation in chemical distribution, can influence the exposure of a receptor to chemicals. One measure of habitat use is indicated by the receptor's home range. That is, species with comparatively large home ranges relative to the area of contamination may be exposed less than those with small home ranges. Home range generally includes the total area in which an animal spends some amount of time during a certain season, including breeding, foraging, roosting, and travel routes (Lincoln and others 1982). Home ranges can vary with gender, reproductive condition, and size of the animal, as well as by season and other dynamic factors. A more appropriate comparison may be the size of the animal's foraging area with the area of contamination if the primary exposure pathway is ingestion.

For the exposure assessment, receptors were assumed to spend their entire lives at Site 13. For the western harvest mouse, this assumption is consistent with available information on home range size, but for the red-tailed hawk, the California quail, and the coyote, this assumption results in an overestimate of exposure because these species forage widely.

#### **11.3.3.3 Ingestion Rate and Diet**

Ingestion can include food, water, soil, and sediment. Although the diet content and ingestion rate may vary seasonally, a receptor's ingestion rate can be defined as a function of its metabolic rate and body size. When available, regional information was used to estimate the body weight and amount of food a receptor ingests. Literature values or allometric regression models (EPA 1993b; 1993c) were used to estimate ingestion rates when regional information was lacking. Ingestion rates are listed in Table 11-8.

Diet composition may be affected by changes in season, availability of prey or forage, reproductive condition, individual variation, and many other factors. Average estimates were used as much as possible. For year-round resident species for which seasonal data were available, diet composition was averaged over seasons. For migratory species, diets of the appropriate season of the year were used. In

some cases, it was necessary to make conservative assumptions due to scarce information and model constraints. These conservative assumptions likely resulted in overestimates of exposure. Diet parameters in the dose model were estimated based on literature values. Diet parameters are listed in Table 11-8.

Many wildlife species ingest soil or sediment while feeding or preening; however, actual incidental ingestion rates are known for only a few species under limited field conditions (Beyer and others 1994; Arthur and Gates 1988). For some receptors, ingestion of contaminated soil or sediment may constitute a significant portion of the total dietary exposure to chemicals. Estimates of incidental ingestion of soil or sediment were gathered from the scientific literature for each receptor of concern, and appropriate values were used in the exposure model. In a study of soil ingestion by wildlife through analysis of the acid-insoluble ash content of scat, Beyer and others (1994) estimated percentage of soil and sediment in the diets of a variety of taxa. Values for receptors at Site 13 were extrapolated from data on species reported in the literature.

#### 11.3.3.4 Site-Specific Doses

Doses were estimated for each COEC and assessment endpoint receptor for which adequate data were available. The assumptions, model parameters, and model output are summarized in Tables 11-8 and 11-9. These doses were then compared to high and low toxicity reference values (TRVs) to estimate the potential adverse biological effects on the receptor (see Section 11.4). Based on this comparison, the risk to each assessment endpoint was characterized; this process is described in more detail in Section 11.4.

The total exposure from ingestion for each of the four receptors (western harvest mouse, coyote, California quail, and red-tailed hawk) was calculated as the sum of the dietary exposure estimates. The following generic equation was adapted for each receptor:

$$\text{Dose}_{\text{total}} = \frac{[(\text{IR}_{\text{prey}} \times \text{C}_{\text{prey}}) + (\text{IR}_{\text{soil}} \times \text{C}_{\text{soil}})] \times \text{SUF}}{\text{BW}}$$

where:

Dose <sub>total</sub>	=	Estimated dose from ingestion (mg/kg bodyweight-day)
IR <sub>prey</sub>	=	Ingestion rate of prey (kg/day)

$C_{\text{prey}}$	=	Estimated concentration of chemical in prey (mg/kg) based on literature-derived biomagnification factor
$IR_{\text{soil}}$	=	Estimated ingestion rate of soil (kg/day)
$C_{\text{soil}}$	=	Maximum concentration of chemical in soil (mg/kg)
BW	=	Estimated body weight (kg)
SUF	=	Site use factor (unitless)

The parameters used in the food chain model are discussed in general in this section; specific model components for each receptor are presented in subsequent sections.

#### 11.3.3.5 Estimates of Chemical Concentration in Prey

Ingestion rates for both food and incidental soil were derived from the literature. Food ingestion rates were apportioned by food item by multiplying the overall food ingestion rate for a receptor by the proportion of the diet that a particular prey item (plant, invertebrate, or vertebrate) contributes on a daily basis (kg/day).

The maximum site concentrations were used as the soil concentrations in the dose model. These values were used in conjunction with a literature-derived biomagnification factor (BMF) to estimate the concentration of chemicals in plant and invertebrate food items. The BMFs used in the food chain model are summarized below:

Chemical of Concern (COEC)	Plant BMFs		Invertebrate BMFs	
	Plant:Soil BMF (unitless)	Literature Reference	Invertebrate:Soil BMF (unitless)	Literature Reference
Beryllium	0.1 <sup>1</sup>		0.1 <sup>1</sup>	
Cadmium	0.384	Pascoe and others 1996	0.205	Pascoe and others 1996
Copper	0.004	Pascoe and others 1996	0.103	Pascoe and others 1996
Lead	0.003	Davies 1990	0.156	Davies 1990
Mercury	0.16	Wren and others 1995 <sup>2</sup>	0.336	Wren and others 1995 <sup>3</sup>
Zinc	0.115	Davies 1990	0.139	Pascoe and others 1996

1. A default value of 0.1 was adapted for this chemical's plant or invertebrate BMF due to insufficient chemical-specific data.
2. Aboveground plant tissue concentrations in a variety of plant species growing in soils with given chemical concentrations.
3. Tissue concentrations in soil-dwelling invertebrates from upland and wetland habitats associated with soils with given chemical concentrations.

The estimated concentrations of chemicals in plants and invertebrates were calculated using the following equations:

$$[\text{Plant}]_{\text{est}} = [\text{Media}] * \text{BMF}_{\text{plant:soil}}$$

where

$[\text{Plant}]_{\text{est}}$	=	Estimated chemical-specific concentration in plant material (mg/kg)
$[\text{Media}]$	=	Chemical-specific concentration in soil (mg/kg)
$\text{BMF}_{\text{plant:soil}}$	=	Chemical-specific biomagnification factor relating the concentration of a chemical in plants to a concentration of the chemical in soil (unitless ratio; $[\text{Plant}]:[\text{Media}]$ )

$$[\text{Invert}]_{\text{est}} = [\text{Media}] * \text{BMF}_{\text{invert:soil}}$$

where

$[\text{Invert}]_{\text{est}}$	=	Estimated chemical-specific concentration in invertebrate tissue (mg/kg)
$[\text{Media}]$	=	Chemical-specific concentration in soil (mg/kg)
$\text{BMF}_{\text{invert:soil}}$	=	Chemical-specific biomagnification factor relating the concentration of a chemical in invertebrates tissue to the concentration of the chemical in soil (unitless ratio; $[\text{Invert}]:[\text{Media}]$ )

The estimated concentrations of chemicals in plant and invertebrate prey, calculated using the maximum concentrations of chemicals in soils from Site 13 and the BMFs described above, are summarized in the following table:

Chemical of Concern (COEC)	Maximum Concentration in Soil x BMF	
	Estimated Concentration in Plants (mg/kg)	Estimated Concentration in Invertebrates (mg/kg)
Beryllium	0.065	0.065
Cadmium	6.03	3.22
Copper	1.54	39.7
Lead	16.77	872.0
Mercury	0.0592	0.124
Zinc	525.6	635.2

Estimates of daily doses to the carnivorous red-tailed hawk and coyote assumed that the body burden of a given chemical in prey (western harvest mouse and quail) was equal to the daily dose ingested by the prey. This method assumes 100 percent assimilation and zero depuration, and is likely to overestimate actual body burden (Pascoe and others 1994b; 1996). Daily doses calculated for the four representative species are presented in Table 11-9.

#### 11.4 ECOLOGICAL EFFECTS ASSESSMENT - SITE 13

The potential ecological effects of site chemicals on species present at the site are discussed in the following sections. Effects on plants are discussed in Section 11.4.1, invertebrates in Section 11.4.2, and vertebrates in Section 11.4.3. Hazard quotients (HQ) for birds and mammals, based on comparing estimated doses with toxicological benchmarks, are presented in Section 11.4.5.

##### 11.4.1 Effects on Plants

No regulatory criteria specify concentrations of chemicals considered safe for plants, so the potential for COECs to cause adverse effects to plants at Site 13 was evaluated based on a literature review. In general, toxic effects of chemicals include chlorosis, growth retardation, reduction in seed germination, and altered enzyme activity. Soil factors such as pH, organic content, and ion exchange capacity can enhance or inhibit these effects. In addition, the presence of multiple chemicals can cause synergistic or antagonistic effects. The assessment of potential ecological effects on plants was based on the maximum

concentrations in soil and sediment, the ability of the plant to translocate these chemicals, and published information on adverse effects of chemicals on plants.

General information on adverse effects of COECs on plants is presented in the toxicological profiles in Appendix P. The maximum concentrations in soil, summarized in Table 11-2, are not likely to be bioavailable to plants, although some fraction will be.

Organic compounds have rarely been reported to bioaccumulate in plants and little is known about their potential physiological effects on plants (Bell and Faileys 1991; Verma and Pillai 1991; Mitra and others 1991). At Site 13, organic chemicals are not expected to pose a risk to plants; only inorganic chemicals were evaluated.

For the ecological effects assessment at the Burn Area, a comprehensive soil analysis and a Microtox bioassay were conducted to provide context for the interpretation of soil toxicity and potential confounding effects in the characterization of risk to plants.

#### **11.4.1.1 Comprehensive Soil Analysis**

In general, factors that recur as prominent causes of poor vegetation stands are often independent of contaminated-related and include effects related to soil pH (or hydrogen ion concentration), salinity, sodicity (elevated sodium concentrations), cation exchange capacity, organic matter, soil texture and structure, and bulk density and porosity.

Soils at the Burn Area are primarily of the Altamont-Diablo-Fontana association, characterized by very steep, well-drained clays and silty clay loams that formed in weathered material originating from soft, fine-grained sandstones and shales on the upland features of the landscape.

For laboratory analysis, two surface (0.0 to 0.5 feet bgs) and eight subsurface (0.5 to 2.5 feet bgs) samples were collected and analyzed. The results of the comprehensive soil analysis are summarized with those from the Microtox bioassay in Table 11-7. All summary statistics compiled in Appendix O were reduced from full data sets using StatMost and GeoEAS as the primary data reduction tools. In addition to the summary statistics and correlation analyses, tests for normality and variance homogeneity

were completed, and indicated that these subsets, derived from the larger RI data collections, were consistently non-normal and heterogeneous, as is typical of environmental samples. In general, the comprehensive soil survey suggested that the physicochemical properties of soils could limit vegetation growth and sustainability, independent of chemical releases known to have occurred at the site (Marschner 1986; Munshower 1994). Specific parameters are discussed below.

### **Texture**

Texture refers to the proportion of particles of different size classes (sand, silt, clay) that make up a sample. Knowledge of texture is important for assessing water relations, erodibility, and retention of cations, anions, and toxicants. At the Burn Area, soils were uniformly silty loams to clay loams in texture.

### **Organic Matter Content**

The organic matter content of a soil is an indicator of its fertility, ability to support microbial populations, retention of elements, and water relations. In general, the greater the organic matter content, the better the soil serves as a medium for plant growth. Overall, soils at the Burn Area were characteristically poor in organic carbon, ranging between less than 0.5 percent to 2 percent total organic carbon (TOC).

### **pH**

Soil pH is a measure of its hydrogen ion concentration (or more accurately, its activity) and thus its acidity or alkalinity. This is an important property because it influences (or regulates) many chemical and biological processes occurring in a soil, including the availability of soil nutrients and metals. Soils at the Burn Area were generally between pH 5.5 and 6.0, with two soil samples measuring pH 6.7 and 6.8.

### **Cation Exchange Capacity**

CEC is a measure of the soil's ability to retain positively charged ions. The greater the CEC, the greater the capacity of a soil to retain cations, and the greater its storage or buffering capacity. CEC is especially



important for assessing the mobility of positively charged metallic elements. At the Burn Area, CEC was relatively high, ranging between 21 to 40 milliequivalents per 100 grams (mEq/100gm).

### **Base Saturation and Extractable Acidity**

These two measurements characterize opposite ends of the spectrum relative to the composition of cations occupying the cation exchange complex of a soil. They are strongly related to the pH of a soil. Base saturation represents the proportion of the CEC electrically satisfied by base cations such as calcium, magnesium, potassium, and sodium, whereas extractable acidity measures the proportion satisfied by the acidity cations, hydrogen, and aluminum. Base saturation at the Burn Area clearly indicated potential for plant nutritional limitations, primarily because of the interactive effects associated with CEC and macronutrients like calcium and magnesium.

### **Electrical Conductivity**

Electrical conductivity is an indirect measurement of the ionic content of a soil sample. The greater the conductivity, the greater the ion content of a soil. It is an especially important measurement in soils that have "free" salts such as saline soils, and serves as an indicator of adverse conditions for growth of many plants in such soils. Base saturation and extractable acidity may be sufficiently elevated to exert phytotoxic effects at Site 13.

### **Water Retention**

Water retention refers to the amount of water that can be retained by soil when it is subjected to different pressures. Characteristically, a "water retention curve" is established for a soil sample by measuring its water content (on either a volumetric or weight basis) at 1/10-, 1/3-, 1-, 5-, and 15-bar pressures. The difference in water contents between the 1/3-bar (also termed field capacity) and 15-bar (wilting point) pressures is termed the available water content of a soil. It represents the amount of water storage the soil can provide against the force of gravity, and the amount available for plant uptake. At the Inland Area, all soil samples fell within the optimum range for water retention.

## Concentrations of Various Elements

Nitrogen deficiency is characterized by small pale plants and retarded growth; the most common plant-available form of the element is the nitrate ion ( $\text{NO}_3^-$ ). Nitrogen is generally stored in the soil as organic matter, and most of the organic fraction occurs in the upper soil horizons. Quite often, disturbed soils are nitrogen-limited since this upper soil horizon is removed or highly disturbed. Soils at the Burn Area are disturbed (for example, trenched and filled in some locations), heavily grazed, and nitrogen deficient; hence, existing vegetation signatures must be evaluated with that precaution.

Phosphorus in soils is generally available to plants as the phosphate ion ( $\text{PO}_4^{2-}$ ), which is critical to early seedling germination and growth. Phosphorus deficiency is generally characterized by reduced seedling growth and reddish-purple discoloration of stems and foliage. Leaf tips, especially on young growing vegetation, may also die in phosphorus deficiency. In the semi-arid regions of the western U.S., much of the phosphorus in soils is not available to the plant. The amount of bioavailable phosphorus depends to a certain extent upon soil organic matter; if the soil organic matter is sufficient, a continual supply of phosphorus is available to plants as a result of organic matter decomposition. Phosphorus at the Burn Area is generally low and may limit vegetation growth independent of any chemical-related effects.

Potassium is critical to the normal physiological function of plants, and its significance to long-term sustainability varies with plant age. As is typical, potassium concentrations in soils at the Burn Area are variable. Plant-potassium interactions are generally not limited in disturbed soils unless phytotoxicity associated with residual materials is apparent.

As a macronutrient, calcium is primarily associated with physiological functions of plant cells and with the plant cell wall. In western soils, total calcium concentration ranges from less than 0.1 percent to 5 percent. Even in disturbed soils, calcium is not likely to occur in deficient or excess concentrations; however, in acidic soils, calcium may be relatively unavailable to plants and corrective measures such as liming should be considered. For the Burn Area, the comprehensive soil analysis indicated that calcium may be limited, in part, by the leached character of the soils, but that nitrogen deficiency probably overshadows those effects.

Magnesium is critical to normal plant functions, including photosynthesis and other plant cell processes. Generally, magnesium concentrations are sufficient for plants even in disturbed soils. However, magnesium may be deficient in acidic soils associated with disturbance. At the Burn Area, magnesium presents vegetation problems similar to calcium, especially when evaluated in terms of percent base saturation when both elements are grossly elevated.

Sulfur is critical to normal plant functions, since it is a constituent in proteins and enzymes required in normal plant processes. A major portion of the soil sulfur is found in organic matter, and sulfur release from soil organic matter occurs slowly as a result of decomposition. While relatively low in TOC, soils at the Burn Area are not particularly limiting with respect to sulfur concentrations.

### **Trace Elements and Micronutrients**

Concentrations of trace elements are highly variable in soils, whether or not they have been disturbed by activities such as grazing. The role of these elements in normal plant function is generally unclear, or varies from one species to another sufficiently to make general characterizations of their function in the soil-plant relationship awkward to define. However, risk managers may have to consider their role in plant-soil interactions to assure long-term sustainability of the plant communities.

#### **11.4.1.2 Biological Assessment Screening Tools**

Ten surface soil samples were subjected to a solid phase Microtox bioassay. Summary statistics of test results are included in Appendix O, along with reduced data for the comprehensive soil analysis.

Spearman Rank and Pearson correlation analysis was completed to evaluate correlation among Microtox results, soil chemistry, and other soil parameters (Zar 1986). Selected cross tabulation summaries are presented in Tables 11-10 and 11-11. Complete summaries of these correlation analyses are included in Appendix O. These analyses suggest that Microtox activity was not strongly correlated with chemical-related analytes measured as part of the comprehensive soil analysis. Rather, highest correlations ( $P \leq 0.05$ ) were observed between Microtox and sulfate-sulfur, cation exchange capacity (CEC) and percent moisture, as well as iron and sulfate-sulfur concentrations.

On the basis of the current RI activities, soils at the Burn Area appear relatively poor from the perspective of plant nutrition; however, this condition may be unrelated to past chemical releases. Extensive compaction of soils and overgrazing at the site have likely contributed to this condition. Soil concentrations of the inorganic COECs (especially, lead and cadmium) may be associated with potential phytotoxicity in plants exposed to these soil chemicals through the rhizosphere, especially given the matrix characterization from the comprehensive soil survey.

Figure 11-2 illustrates spatial trends in linkages among total metals in bulk soils, WET metal concentrations, and biological responses based on Microtox. Lead is plotted on the Burn Area map by sample locations, with each sample point identified with a total lead and WET lead concentrations coincident with Microtox results. The ten samples plotted on 11-2 are locations where Microtox, WET lead, and total lead were analyzed.

#### **11.4.2 Effects on Invertebrates**

Effects on soil-dwelling invertebrates were evaluated by comparison of soil concentrations of COECs to benchmark values available in the ecotoxicological literature. Soil concentrations that reflect no-observable-adverse-effect concentrations (NOAECs) for soil invertebrates (including litter-dwelling invertebrates) and heterotrophic processes (see Table 11-1) were compiled from Will and Suter (1995b)

For soil- and litter-dwelling terrestrial invertebrates, soil and litter benchmark values are frequently exceeded by ambient concentrations at Site 13 (see Table 11-1), suggesting that regional differences in baseline conditions must be addressed if soil toxicity is to be adequately evaluated at the Burn Area. Ambient values for chromium, copper, and mercury exceeded benchmark soil levels, rendering them invalid for risk assessment at this site. Site-specific concentrations of barium, lead, nickel, and zinc exceeded benchmark values. Although limited, the terrestrial plant benchmarks for soil- and litter-dwelling invertebrates suggest cadmium, lead and zinc as potentially problematic chemicals.

Physical and chemical characteristics of the soils at the Burn Area (for example, soil pH) suggest ambient conditions may be marginal for maintaining a diverse plant community. These conditions may be independent of chemical releases, or acting in concert with COECs to limit vegetation growth and vigor.

#### **11.4.3 Effects on Vertebrates (Birds and Mammals)**

The conceptual food chain for the Burn Area was developed in the problem formulation section and is illustrated in Figure 11-1. Food-chain models in ERAs are used to predict chemical exposures, through estimations of intake rates and body burdens, for higher trophic level organisms to chemicals in soil and food sources (Pascoe and others 1994a; 1994b; 1996; Pastorok and others 1996).

The deterministic model introduced in Section 11.2 was used to evaluate trophic transfer of chemicals. Data requirements for food-chain analysis were met for cadmium, copper, lead, mercury, and zinc. For beryllium, data were insufficient to develop a screening value based on trophic transfer of chemicals.

#### **11.4.4 Toxicity Reference Values (TRV)**

TRVs are screening level benchmark values for higher trophic level receptors such as birds and mammals. A TRV is a daily dose level associated with known biological effects on laboratory animals derived from peer-reviewed literature. TRVs were compared to site-specific estimated doses and used to evaluate risk due to ingested chemicals. TRVs were derived for chemicals and receptors specific to Navy installations through a collaborative effort involving the Navy and its contractors and the EPA Region 9 Bio-Technical Assistance Group (BTAG). The BTAG includes federal, state, and local regulatory agencies and resource trustees.

##### **TRV Methodology**

TRVs were derived using the methods described in "Development of Toxicity Reference Values as Part of a Regional Approach for Conducting Ecological Risk Assessments at Naval Facilities in California" (PRC 1997). This document includes a review of the literature search strategy, criteria used to select TRVs, and an evaluation of sources of uncertainty. TRVs for mammalian and avian receptors are summarized in Table 11-12.

Risk to representative species was characterized by the HQ approach, calculated by dividing the site-specific estimated dose by the literature-derived TRV ( $HQ = \text{Dose} / \text{TRV}$ ). The dose estimate was divided by both the high and the low TRV, resulting in two HQs for each COEC-receptor pair that span

the range of possible risk identified by this method. As explained in regulatory guidance (EPA 1989b), the HQ approach indicates that receptors may be at risk if the HQ exceeds 1.0. Due to differences in the degree of conservatism in selection of TRVs for various COECs and receptors, the resulting HQ values should not be compared between COECs or receptors but should be considered individually.

The worst-case scenario (HQ<sub>1</sub>), represented by the case where the HQ calculated using the high TRV is greater than 1.0, indicates a high likelihood of risk to that receptor from that COEC. The dose was estimated using conservative assumptions (such as maximum concentrations of chemicals). The high TRV represents the low- to mid-range of doses that caused observable effects in laboratory animals and does not necessarily represent immediate risk. A HQ<sub>1</sub> much greater than 1.0, using the high TRV, indicated a great potential for risk and warrants a risk management decision; a value less than 1.0 indicated no immediate risk, but assumptions and other evidence were evaluated in support of that conclusion.

The best-case scenario (HQ<sub>2</sub>), represented by the situation in which the HQ calculated using the low TRV is less than or equal to 1.0, indicates no risk from exposure of that receptor to that COEC. Low TRVs represent the lowest concentration at which no adverse effects were observed in laboratory animals. An HQ<sub>2</sub> less than 1.0, using the low TRV, indicated little or no risk. In this case, an HQ<sub>2</sub> greater than 1.0 was not considered to represent immediate risk because the assumptions were very conservative; values greater than 1.0 were further evaluated to identify cases where the possibility of risk was highest.

These two HQ values provide relatively clear-cut decision criteria for higher trophic-level receptors at the site. The purpose of calculating these two HQ values was to bracket the range of risk and to identify specific COECs that presented either no risk or significant risk to receptors.

#### **11.4.5 Hazard Quotients for Birds and Mammals**

HQs have a relatively long history in ERAs, especially those focused on chemicals intentionally or accidentally released to the environment (see Urban and Cook 1986; Tiebout and Brugger 1995). HQs greater than unity indicate the potential for a toxic response, but the quotient cannot be used to gauge either the probability or magnitude of chemical toxicity. HQs and estimated daily doses vary among

receptors based on home ranges and foraging preferences. HQs allow a relative ranking of the potential hazard of each chemical, and indicate only that a chemical at the Burn Area may occur at a concentration that exceeds laboratory-derived no observable effect levels. Absolute quantification is not intended; the analysis presented is screening level only.

Table 11-13 summarizes HQs for those COECs that presented sufficient data for food-chain analysis. The only HQ<sub>1</sub> (dose/high TRV) that exceeded 1.0 was for lead and the California quail (HQ<sub>1</sub> = 221). The HQ<sub>2</sub> for lead was 1,330 for the quail and 1,300 for the western harvest mouse. Cadmium resulted in HQ<sub>2</sub>s greater than 1.0 for the quail (2.5), western harvest mouse (20.0), and coyote (25.7). These slightly elevated HQ<sub>2</sub>s may represent some risk, but are not considered cause for immediate remedial action. The HQ<sub>2</sub> is a conservative value based on assumptions of 100 percent bioavailability of the maximum site concentration of a chemical during a receptor's entire lifetime. Limitations in interpreting HQs near unity are discussed further in Urban and Cook (1986) and Tiebout and Brugger (1995).

While absolute differences between calculated HQs must be interpreted with caution, order of magnitude differences may suggest biologically significant differences in exposure and effects. Alternatively, order of magnitude differences in HQs may also reflect uncertainty in the calculation of daily doses or TRVs for specific COECs. Regardless of the sources of these differences, HQs should be viewed not in strictly quantitative terms, but in conjunction with other lines of evidence (Urban and Cook 1986; Tiebout and Brugger 1995). Risk posed by other COECs not addressed through food-chain modeling should be considered a data gap.

## **11.5 RISK CHARACTERIZATION AND CONCLUSIONS**

Two of the five IR sites in the Inland Area of NWS Concord were considered in the ERA. Data limitations and uncertainty are discussed in Section 11.5.1. Site 13 (Burn Area) is discussed in Section 11.5.2; Site 17 (Seal Creek) is discussed in Section 11.5.3. Summaries and recommendations for the other three sites are discussed in Section 13.0.

### **11.5.1 Data Limitations and Sources of Uncertainty**

The data summarized here were collected during the RI and supported a screening level ERA. In a screening level ERA, conservative assumptions are the usual surrogates when site-specific data are unavailable. Although intended to err on the side of protectiveness, these assumptions introduce uncertainty into the risk assessment.

#### **11.5.1.1 Data Limitations**

Data limitations include:

- For the terrestrial vertebrate food-chain analysis, frequency and duration of Burn Area use by representative receptors use were based on a conservative interpretation of natural history literature (for example, home ranges) compiled in technical support documents and wildlife literature (see for example, EPA 1993b,c). In addition, literature-derived values for natural history parameters may not reflect site conditions.
- Biological tests of affected media to characterize the potential toxicity of chemical mixtures were limited to Microtox; no phytotoxicity tests or soil invertebrate tests were completed with bulk soils to evaluate potential adverse effects associated with COECs.
- Samples sizes at Site 17 limited the interpretation of risk posed by sediment in Seal Creek.
- No site-specific tissue samples were collected or analyzed. Bioaccumulation factors were estimated, rather than measured, for use in food-chain models.

#### **11.5.1.2 Sources of Uncertainty**

Assumptions used at Site 13 included (1) life time exposure duration for receptors; (2) exposure to maximum chemical concentrations detected at the site; and (3) chemicals are in a form that is 100 percent available to receptors. Although conservative, these assumptions introduce uncertainty in the risk assessment. Other sources of uncertainty are presented briefly below.

#### **Exposure Route**

Ingestion is assumed to be the primary route of exposure for ecological receptors at the Burn Area. Default ingestion rates for food and soil were derived from the literature. Actual ingestion rates by site



biota may vary from those values listed in Table 11-8, causing an overestimation or underestimation of risk.

Inhalation exposure to indicator chemicals was not included in this risk analysis. As a result, risk may be slightly underestimated but, given the COECs and their associated environmental fates (Adriano 1992; Alloway 1990), the underestimation is assumed to be insignificant.

Dermal absorption of chemicals was assumed to be negligible and was excluded from this ERA. This may have led to a slight underestimate of total risk associated with the Burn Area, especially as that relates to coincidental ingestion of soil in grooming activities common to birds and mammals. Dermal absorption may be a more important route of exposure for soil-dwelling invertebrates at the site.

### **Chemical Concentrations in Biota**

Several factors that contribute to uncertainty in the estimation of chemical concentrations in biota are discussed below.

**Bioavailability.** Physical and biological factors can influence the bioavailability of chemicals in soil to receptors. The comprehensive soil analysis, Microtox bioassay, and other tools were used to estimate bioavailability; however, this remains a source of uncertainty.

**Biomagnification Factors.** Soil factors such as those described in the comprehensive soil analysis affect plant uptake, resulting in an overestimation or underestimation of exposure and risk. For the Burn Area, plant uptake factors derived from the literature were used in evaluating food-chain transfer. Plant:soil values in the literature are limited and not specific to the soil type at the Burn Area. Reported uptake factors for different plant species vary by an order of magnitude. To account for this variability, conservative estimates of the dietary makeup of species foraging on plants at the site were used.

**Body Burden.** The assumption that the body burden of vertebrate prey for any chemical is equal to its daily intake may cause an overestimation of dose to predators. Measured assimilation and depuration factors are expected to differ significantly from this assumption.

**Chemical Speciation.** The toxicity of a chemical is in part a factor of its form. Levels of mercury detected at Site 13 were not considered elevated. However, in its organic form, mercury bioaccumulates and can become a problem for higher level predators. The analysis used did not differentiate organic from inorganic mercury. However, mercury does not occur at high frequency in the Burn Area, and is not expected to be in the organic form, based on regional soil characteristics.

#### **Potential Confounding Noncontaminant Stressors**

Distinguishing contaminant-related ecological effects from noncontaminant ecological effects is often difficult, if not impossible, given the present practices available for ERAs. Even in comprehensive field and laboratory efforts at sites where known multiple stressors are apparent, these linkages between stressors and ecological effects may be poorly understood. Nonetheless, ecological risks associated with land use must be considered in the characterization of contaminant risks, since the expression of adverse ecological effects may be similar, if not identical, and the impacts of potential remediation must be weighed with these confounding factors well in hand. At the Burn Area, grazing and related agricultural practices serve as potential confounding effects in evaluating ecological risks associated with past contaminant releases.

#### **11.5.2 Risk Characterization Summary - Site 13 (Burn Area)**

In the absence of clearly established regulatory criteria for chemicals in upland soils, evaluation focused on other lines of evidence. Potential risks to terrestrial ecological receptors from chemicals at the Burn Area were evaluated using multiple lines of evidence, including (1) comparison of chemical concentrations to ambient levels; (2) comparison of extraction data to aquatic toxicity values; (3) calculation of HQs based on estimated daily doses and effects levels for selected terrestrial vertebrates; and (4) evaluation of other measures of bioavailability.

Several inorganic chemicals were detected above ambient levels in greater than 10 percent of the soil samples from the Burn Area included antimony, barium, beryllium, cadmium, lead, and zinc. Other than comparison to ambient concentrations, no screening guidelines for soil concentrations are available.

Copper, lead, mercury, and zinc detected in WET-DI from soil samples exceeded the chronic freshwater AWQC. WET metal concentrations were generally two to three orders of magnitude less than metal concentrations in bulk soils, indicating that total metals measured in bulk soil are not bioavailable. Additionally, weak acid metal extractions completed as part of the comprehensive soil analysis indicated limited availability of both nutritive and potentially toxic metals, especially in surface soils where incidental ingestion of soil by terrestrial animals is most likely. Microtox bioassays indicated limited adverse effects at the site. Grassland habitat at the Burn Area is predominantly non-native and highly disturbed, confounding interpretations of contaminant-related stress. Based on soil measures of tilth and productivity, the site contains marginal grassland habitat that appears undifferentiated from the surrounding acreage.

A secondary assessment of risk posed by chemicals in soils at Site 13 focused on trophic transfer of contaminants from soil to plant and animal receptors. Results of the food-chain evaluation using conservative exposure parameters indicated potential risk to terrestrial mammals and birds from lead, based on HQs using high TRVs. Mercury and zinc evaluations resulted in HQs between 1.0 and 5.0, when low TRVs were used; these chemicals were not considered to present a significant risk. All HQs were calculated using maximum concentrations of chemicals in soil samples; actual exposures in the field is expected to be significantly less based on estimates of bioavailability such as WET-DI and soils analysis.

The Burn Area is recommended for no additional remedial action beyond that proposed based on human health risk assessment based on these screening evaluations, observations of the site during field surveys, and the land-use options being considered for the site (that is, no change in management practice).

### **11.5.3 Risk Characterization Summary - Site 17 (Seal Creek)**

Evaluation of ecological risk at Site 17 focused on the sediment near the former discharge pipe in Seal Creek, rather than on the entire area near Building IA-24. Potential contaminant sources for Seal Creek from chemicals in soils near Building IA-24 attenuate in the pathways to Seal Creek, and thus is not expected to pose any risk to ecological receptors in Seal Creek. Data from a single soil sample taken from the bank of the creek were considered in the ERA, as soil from that location could reasonably be expected to erode into the creek in the future.

Risk to aquatic biota at Seal Creek was evaluated by comparing site-specific sediment data to (1) site-specific soil ambient concentrations, and (2) effects ranges published by NOAA (Long and others 1995). Beryllium in sediment samples exceeded ambient concentrations for soils in the area. In the single soil sample collected from the creek bank near the discharge pipe, several metals exceeded ambient concentrations; however, only nickel also exceeded the ER-M. TPH-motor oil was detected in sediments at concentrations up to 4,100 mg/kg, indicating that the steam cleaner outfall has contaminated the stream bed; however, these hydrocarbons will eventually biodegrade. No SVOCs or VOCs were detected in sediments.

Sediment extraction data were compared to freshwater chronic AWQC. Zinc exceeded the AWQC in one WET extraction sample. This portion of Seal Creek is deeply scoured during winter storms; sediment sampled during this RI is not necessarily representative of past or future condition due to sediment dynamics. Evaluation of the chemical results indicated little cause for concern. No ecological risk analysis for Site 17 was conducted. However, because Seal Creek is a functional riparian zone potentially affected by activities on the base, its long term management should be addressed under the Natural Resource Management Plan.

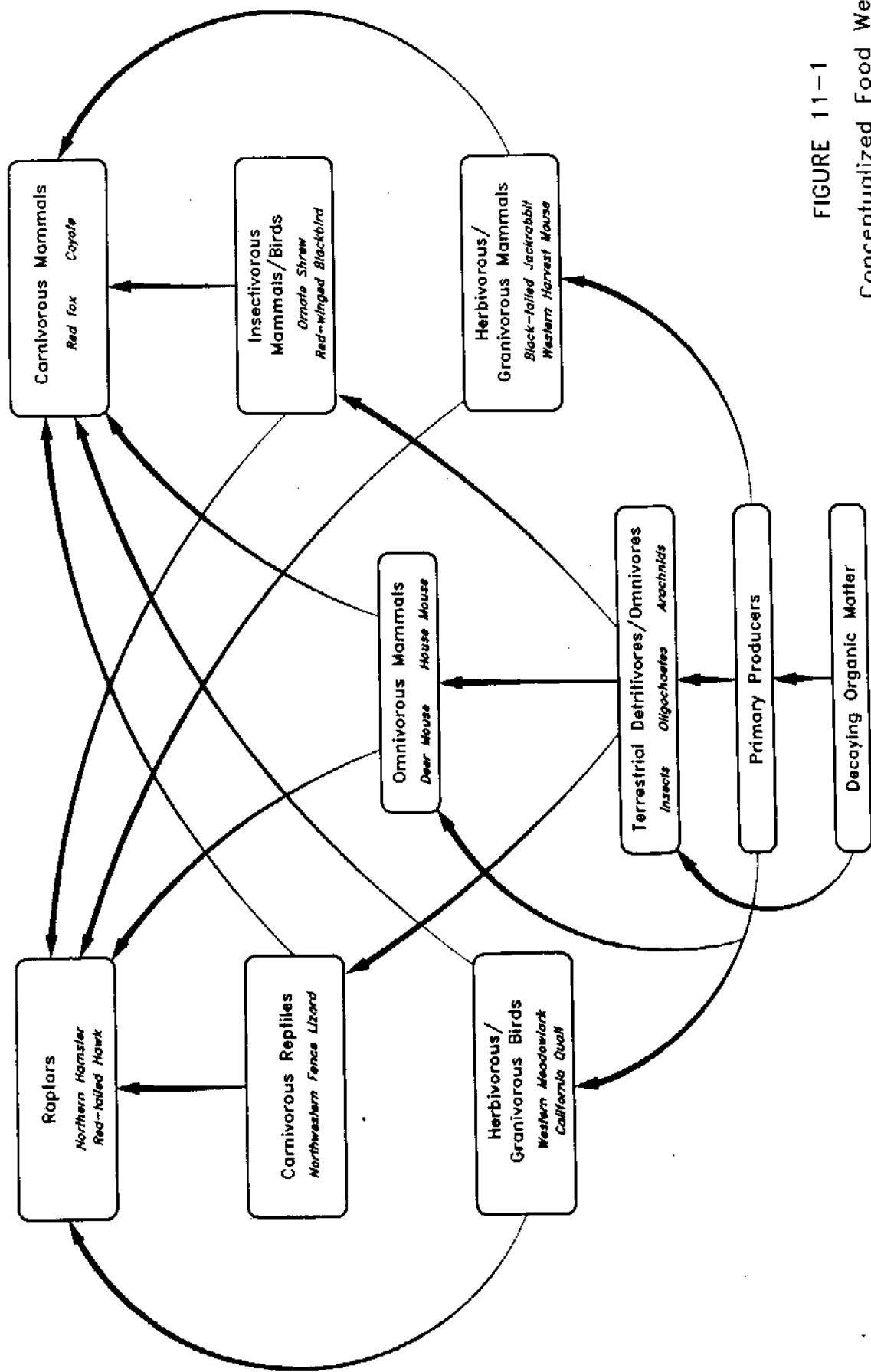


FIGURE 11-1

Conceptualized Food Web  
for Upland Habitat  
At Concord Inland, Burn Area

TABLE 11-1

**SCREENING GUIDANCE VALUES FOR SOIL AND LITTER ORGANISMS AND  
HETEROTROPHIC PROCESSES AND TERRESTRIAL PLANTS  
(COMPILED FROM WILL AND SUTER, 1995A,B)**

Burn Area COEC [Max.] <sup>1</sup> [Background] <sup>2</sup>	Soil and Litter Benchmark (mg/kg soil)	Critical Soil and Litter Receptor (mg/kg soil)	Terrestrial Plant Benchmark (mg/kg soil)
Antimony 84.2                      0.9	na <sup>3</sup>	---	5
Barium 50,500                      560	3000	Microbial process	500
Beryllium 0.90                      0.12	na	---	10
Cadmium 15.7                      0.28	20	Earthworms	3
Chromium 546                      62	0.4	Earthworms	1
Copper 2,090                      65	50	Earthworms	100
Lead 5,590                      32	500	Earthworms	50
Mercury 0.84                      0.17	0.1	Earthworms	0.3
Nickel 244                      100	200	Earthworms	30
Silver 118                      DL	50	Microbial process	2
Thallium 2.5                      1.4	na	---	1
Zinc 4,570                      99	200	Earthworms	50

<sup>1</sup>maximum concentration found in soils; values in mg/kg.

<sup>2</sup>ambient concentration for Concord Inland, Burn Area; values in mg/kg.

<sup>3</sup>na = not available (insufficient data for developing preliminary screening value)

Table 11-2

## Statistical Summary of Soil Analytical Results for Site 13

Analysis	Analyte	Unit	Detected Results										Detection Frequency		
			Surface					Sub-Surface							
			Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range	Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range	Total	Ambient Values (MG/KG)	Above Ambient Values
TOTAL ORGANIC CARBON	TOTAL ORGANIC CARBON	MG/KG	5,700	5,700	5,700	100	100 - 100	2,100	11,000	5,200	100	100 - 130	6/7	*	*
ANIONS	NITRATE	MG/KG	0.20	2.9	0.73	0.20	0.20 - 0.20	0.32	3.0	0.61	0.20	0.20 - 0.20	73/98	*	*
	NITRITE	MG/KG	0.33	0.33	0.15	0.30	0.30 - 0.30	ND	ND	ND	0.30	0.30 - 0.30	1/98	*	*
HEXAVALENT CHROMIUM	HEXAVALENT CHROMIUM	UG/KG	ND	ND	ND	50.0	50.0 - 50.0	ND	ND	ND	50.0	50.0 - 50.0	0/10	*	*
DIOXIN	1,2,3,4,6,7,8-EPICDD	UG/KG	ND	ND	ND	0.08	0.05 - 0.1	ND	ND	ND	0.1	0.1 - 0.1	0/10	*	*
	1,2,3,4,6,7,8-EPICDF	UG/KG	ND	ND	ND	0.05	0.03 - 0.1	ND	ND	ND	0.07	0.07 - 0.07	0/10	*	*
	1,2,3,4,7,8,9-EPICDF	UG/KG	ND	ND	ND	0.05	0.03 - 0.1	ND	ND	ND	0.07	0.07 - 0.07	0/10	*	*
	1,2,3,4,7,8-EPICDD	UG/KG	ND	ND	ND	0.1	0.07 - 0.1	ND	ND	ND	0.2	0.2 - 0.2	0/10	*	*
	1,2,3,4,7,8-EPICDF	UG/KG	ND	ND	ND	0.06	0.04 - 0.09	ND	ND	ND	0.06	0.06 - 0.06	0/10	*	*
	1,2,3,6,7,8-EPICDD	UG/KG	ND	ND	ND	0.1	0.07 - 0.1	ND	ND	ND	0.2	0.2 - 0.2	0/10	*	*
	1,2,3,6,7,8-EPICDF	UG/KG	ND	ND	ND	0.06	0.04 - 0.09	ND	ND	ND	0.06	0.06 - 0.06	0/10	*	*
	1,2,3,7,8,9-EPICDD	UG/KG	ND	ND	ND	0.1	0.07 - 0.1	ND	ND	ND	0.2	0.2 - 0.2	0/10	*	*
	1,2,3,7,8,9-EPICDF	UG/KG	ND	ND	ND	0.06	0.04 - 0.09	ND	ND	ND	0.06	0.06 - 0.06	0/10	*	*
	1,2,3,7,8-PEICDD	UG/KG	ND	ND	ND	0.1	0.08 - 0.3	ND	ND	ND	0.2	0.2 - 0.2	0/10	*	*
	1,2,3,7,8-PEICDF	UG/KG	ND	ND	ND	0.08	0.04 - 0.1	ND	ND	ND	0.1	0.1 - 0.1	0/10	*	*
	2,3,4,6,7,8-EPICDF	UG/KG	ND	ND	ND	0.06	0.04 - 0.09	ND	ND	ND	0.06	0.06 - 0.06	0/10	*	*
	2,3,4,7,8-PEICDF	UG/KG	ND	ND	ND	0.08	0.04 - 0.1	ND	ND	ND	0.1	0.1 - 0.1	0/10	*	*
	2,3,7,8-TCDD	UG/KG	ND	ND	ND	0.04	0.02 - 0.06	ND	ND	ND	0.06	0.06 - 0.06	0/10	*	*
	2,3,7,8-TCDF	UG/KG	ND	ND	ND	0.08	0.05 - 0.1	ND	ND	ND	0.1	0.1 - 0.1	0/10	*	*
	HPICDDs (TOTAL)	UG/KG	ND	ND	ND	0.08	0.05 - 0.1	ND	ND	ND	0.1	0.1 - 0.1	0/10	*	*
	HPICDFs (TOTAL)	UG/KG	ND	ND	ND	0.05	0.03 - 0.1	ND	ND	ND	0.07	0.07 - 0.07	0/10	*	*
	HCDDs (TOTAL)	UG/KG	ND	ND	ND	0.1	0.07 - 0.1	ND	ND	ND	0.2	0.2 - 0.2	0/10	*	*
	HCDFs (TOTAL)	UG/KG	ND	ND	ND	0.06	0.04 - 0.09	ND	ND	ND	0.06	0.06 - 0.06	0/10	*	*
	OCDD	UG/KG	ND	ND	ND	0.3	0.1 - 0.7	ND	ND	ND	0.4	0.4 - 0.4	0/10	*	*
	OCDF	UG/KG	ND	ND	ND	0.2	0.06 - 0.3	ND	ND	ND	0.2	0.2 - 0.2	0/10	*	*
	PEICDDs (TOTAL)	UG/KG	ND	ND	ND	0.1	0.08 - 0.3	ND	ND	ND	0.2	0.2 - 0.2	0/10	*	*
	PEICDFs (TOTAL)	UG/KG	ND	ND	ND	0.08	0.04 - 0.1	ND	ND	ND	0.1	0.1 - 0.1	0/10	*	*
	TCDDs (TOTAL)	UG/KG	ND	ND	ND	0.04	0.02 - 0.06	ND	ND	ND	0.06	0.06 - 0.06	0/10	*	*
	TCDFs (TOTAL)	UG/KG	ND	ND	ND	0.08	0.05 - 0.1	ND	ND	ND	0.1	0.1 - 0.1	0/10	*	*
SEMIVOLATILES	1,2,4-TRICHLOROBENZENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	1,2-DICHLOROBENZENE	UG/KG	ND	ND	ND	380	180 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	1,3-DICHLOROBENZENE	UG/KG	ND	ND	ND	380	180 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	1,4-DICHLOROBENZENE	UG/KG	ND	ND	ND	380	180 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	2,2'-OXYBIS(1-CHLOROPROPANE)	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	2,4,5-TRICHLOROPHENOL	UG/KG	ND	ND	ND	960	860 - 1,100	ND	ND	ND	980	910 - 1,100	0/82	*	*
	2,4,6-TRICHLOROPHENOL	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*

ND = Not Detected

Ambient values for metals are in milligrams per kilogram (mg/kg).

The average was calculated using the detected values and 1/2 of the sample quantitation limit for nondetects.

Organic results less than 10 are reported to one significant figure, and results greater than 10 are reported to two significant figures.

Inorganic results less than 10 are reported to two significant figures, and results greater than 10 are reported to three significant figures.

\* Screening value not available

Surface samples are samples with bottom sample depth less than and equal to one foot. Subsurface samples are samples with bottom sample depth greater than one foot but less than four feet.

Table 11-2 (Continued)

## Statistical Summary of Soil Analytical Results for Site 13

Analysis	Analyte	Unit	Detection Results										Detection Frequency		
			Surface					Sub-Surface					Total	Ambient Values (MG/KG)	Above Ambient Values
			Minimum	Maximum	Average	Detection Limit	Detection Limit Range	Minimum	Maximum	Average	Detection Limit	Detection Limit Range			
SEMIVOLATILES	2,4-DICHLOROPHENOL	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	2,4-DIMETHYLPHENOL	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	2,4-DINITROPHENOL	UG/KG	ND	ND	ND	960	860 - 1,100	ND	ND	ND	980	910 - 1,100	0/82	*	*
	2,4-DINITROTOLUENE	UG/KG	120	120	190	390	340 - 420	ND	ND	ND	400	360 - 430	1/82	*	*
	2,6-DINITROTOLUENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	2-CHLORONAPHTHALENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	2-CHLOROPHENOL	UG/KG	ND	ND	ND	390	340 - 420	190	190	200	400	360 - 430	1/82	*	*
	2-METHYLNAPHTHALENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	2-METHYLPHENOL	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	2-NITROANILINE	UG/KG	ND	ND	ND	960	860 - 1,100	ND	ND	ND	980	910 - 1,100	0/82	*	*
	2-NITROPHENOL	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	3,3'-DICHLOROBENZIDINE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	3-NITROANILINE	UG/KG	ND	ND	ND	960	860 - 1,100	ND	ND	ND	980	910 - 1,100	0/82	*	*
	4,6-DINITRO-2-METHYLPHENOL	UG/KG	ND	ND	ND	960	860 - 1,100	ND	ND	ND	980	910 - 1,100	0/82	*	*
	4-BROMOPHENYL-PHENYLETHER	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	4-CHLORO-3-METHYLPHENOL	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	4-CHLOROANILINE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	4-CHLOROPHENYL-PHENYLETHER	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	4-METHYLPHENOL	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	4-NITROANILINE	UG/KG	ND	ND	ND	960	860 - 1,100	ND	ND	ND	980	910 - 1,100	0/82	*	*
	4-NITROPHENOL	UG/KG	ND	ND	ND	960	860 - 1,100	ND	ND	ND	980	910 - 1,100	0/82	*	*
	ACENAPHTHENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	ACENAPHTHYLENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	ANTHRACENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	BENZO (A) ANTHRACENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	BENZO (A) PYRENE	UG/KG	70	70	190	390	340 - 420	270	270	200	400	360 - 430	2/82	*	*
	BENZO (B) FLUORANTHENE	UG/KG	ND	ND	ND	390	340 - 420	450	450	200	400	360 - 430	1/82	*	*
	BENZO (G,H,I) PERYLENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	BENZO (K) FLUORANTHENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	BIS (2-CHLOROETHOXY) METHANE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	BIS (2-CHLOROETHYL) ETHER	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	BIS (2-ETHYLHEXYL) PHTHALATE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	BUTYLBENZYLPHTHALATE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	CARBAZOLE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	CHRYSENE	UG/KG	43	43	190	390	340 - 420	210	210	200	400	360 - 430	3/82	*	*
	DI-N-BUTYLPHTHALATE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	DI-N-OCTYLPHTHALATE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*
	DIBENZ (A,H) ANTHRACENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*

ND = Not Detected

Ambient values for metals are in milligrams per kilogram (mg/kg).

The average was calculated using the detected values and 1/2 of the sample quantitation limit for nondetects.

Organic results less than 10 are reported to one significant figure, and results greater than 10 are reported to two significant figures.

Inorganic results less than 10 are reported to two significant figures, and results greater than 10 are reported to three significant figures.

\* Screening value not available

Surface samples are samples with bottom sample depth less than and equal to one foot. Subsurface samples are samples with bottom sample depth greater than one foot but less than four feet.



Table 11-2 (Continued)

## Statistical Summary of Soil Analytical Results for Site 13

Analysis	Analyte	Unit	Detected Results											Detection Frequency		
			Surface					Sub-Surface						Total	Ambient Values (MG/KG)	Above Ambient Values
			Minimum	Maximum	Average	Detection Limit	Detection Limit Range	Minimum	Maximum	Average	Detection Limit	Detection Limit Range				
SEMIVOLATILES	DIBENZOPURAN	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*	
	DIETHYLPHTHALATE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*	
	DIMETHYLPHTHALATE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*	
	FLUORANTHENE	UG/KG	26	31	190	390	340 - 420	ND	ND	ND	400	360 - 430	2/82	*	*	
	FLUORENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*	
	HEXACHLOROBENZENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*	
	HEXACHLOROBUTADIENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*	
	HEXACHLOROCYCLOPENTADIENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*	
	HEXACHLOROETHANE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*	
	HIGH MOLECULAR PAHs	UG/KG	74	170	7	390	340 - 420	1,200	1,200	27	400	360 - 430	3/82	*	*	
	INDENO (1,2,3-CD) PYRENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/81	*	*	
	ISOPHORONE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*	
	LOW MOLECULAR PAHs	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*	
	N-NITROSO-DI-N-PROPYLAMINE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*	
	N-NITROSODIPHENYLAMINE (1)	UG/KG	63	63	190	390	340 - 420	ND	ND	ND	400	360 - 430	1/82	*	*	
	NAPHTHALENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*	
	NITROBENZENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*	
	PENTACHLOROPEENOL	UG/KG	ND	ND	ND	560	860 - 1,100	ND	ND	ND	970	370 - 1,100	0/82	*	*	
	PHENANTHRENE	UG/KG	ND	ND	ND	390	340 - 420	ND	ND	ND	400	360 - 430	0/82	*	*	
	PHENOL	UG/KG	ND	ND	ND	390	340 - 420	240	1,900	270	400	360 - 430	8/82	*	*	
	PYRENE	UG/KG	31	31	190	390	340 - 420	250	250	200	400	360 - 430	2/82	*	*	
	TOTAL PAHs	UG/KG	74	170	7	390	340 - 420	1,200	1,200	27	400	360 - 430	3/82	*	*	
	TOTAL METALS	ALUMINUM	MG/KG	6,660	32,000	15,200	1.5	1.3 - 1.7	6,540	54,800	14,000	1.6	1.4 - 2.2	98/98	21000	6/98
		ANTIMONY	MG/KG	0.41	84.2	2.6	0.44	0.34 - 0.48	0.37	13.8	0.57	0.46	0.34 - 0.58	32/96	0.9	10/96
ARSENIC		MG/KG	2.4	8.7	4.5	0.35	0.29 - 0.51	1.7	19.4	4.7	0.36	0.31 - 0.64	84/98	10	1/98	
BARIUM		MG/KG	103	1,670	356	0.15	0.080 - 0.41	63.0	18,300	580	0.13	0.090 - 0.52	98/98	560	10/98	
BERYLLIUM		MG/KG	0.21	0.63	0.18	0.018	0.0060 - 0.030	0.23	0.65	0.17	0.020	0.0060 - 0.030	30/98	0.12	30/98	
CADMIUM		MG/KG	0.31	15.7	0.56	0.024	0.020 - 0.041	0.24	0.80	0.094	0.023	0.020 - 0.052	17/98	0.29	16/98	
CALCIUM		MG/KG	2,570	32,800	6,630	4.6	2.5 - 14.5	2,000	83,300	8,760	4.2	2.7 - 18.3	98/98	*	*	
CHROMIUM		MG/KG	19.5	78.6	38.7	0.22	0.13 - 0.25	17.3	546	40.2	0.23	0.13 - 0.31	93/98	62	8/98	
COBALT		MG/KG	7.5	24.7	15.9	0.12	0.080 - 0.23	4.5	40.5	15.0	0.11	0.090 - 0.28	98/98	24	5/98	
COPPER		MG/KG	11.4	385	51.1	0.13	0.10 - 0.23	15.3	82.0	32.1	0.13	0.11 - 0.28	98/98	65	6/98	
IRON		MG/KG	8,740	43,600	22,200	2.8	2.1 - 5.0	8,900	60,000	20,500	2.8	2.3 - 6.3	98/98	*	*	
LEAD		MG/KG	5.0	5,590	169	0.30	0.24 - 0.33	4.5	3,090	65.8	0.31	0.24 - 0.40	91/98	33	14/98	
MAGNESIUM		MG/KG	1,730	22,500	7,330	2.6	1.1 - 9.6	2,710	98,500	8,170	2.2	1.1 - 12.1	98/98	*	*	
MANGANESE		MG/KG	160	1,890	738	0.046	0.032 - 0.050	69.4	3,090	608	0.049	0.032 - 0.060	98/98	1200	7/98	
MERCURY		MG/KG	0.060	0.37	0.078	0.037	0.010 - 0.060	0.060	0.26	0.070	0.037	0.013 - 0.080	48/98	0.17	7/98	
MOLYBDENUM		MG/KG	ND	ND	ND	0.18	0.14 - 0.20	ND	ND	ND	0.19	0.14 - 0.24	0/98	*	*	

ND = Not Detected

Ambient values for metals are in milligrams per kilogram (mg/kg).

The average was calculated using the detected values and 1/2 of the sample quantitation limit for nondetects.

Organic results less than 10 are reported to one significant figure, and results greater than 10 are reported to two significant figures.

Inorganic results less than 10 are reported to two significant figures, and results greater than 10 are reported to three significant figures.

\* Screening value not available

Surface samples are samples with bottom sample depth less than and equal to one foot. Subsurface samples are samples with bottom sample depth greater than one foot but less than four feet.

Table 11-2 (Continued)

## Statistical Summary of Soil Analytical Results for Site 13

Analysis	Analyte	Unit	Detection Results										Detection Frequency		
			Surface					Sub-Surface					Total	Ambient Values (MG/KG)	Above Ambient Values
			Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range	Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range			
TOTAL METALS	NICKEL	MG/KG	14.3	125	59.0	0.30	0.26 - 0.33	17.1	361	58.4	0.32	0.26 - 0.41	97/98	100	4/98
	POTASSIUM	MG/KG	134	3,650	1,360	10.1	7.7 - 11.1	163	3,800	1,200	10.6	7.8 - 13.4	96/98	*	*
	SELENIUM	MG/KG	ND	ND	ND	0.77	0.48 - 0.88	ND	ND	ND	0.82	0.48 - 1.1	0/98	*	*
	SILVER	MG/KG	0.12	1.6	0.13	0.14	0.10 - 0.25	0.57	0.57	0.077	0.14	0.11 - 0.31	4/98	*	*
	SODIUM	MG/KG	56.5	430	127	37.1	25.6 - 73.7	82.9	1,870	377	36.1	28.9 - 92.7	65/98	*	*
	THALLIUM	MG/KG	0.52	2.5	0.31	0.30	0.050 - 0.38	0.39	1.2	0.27	0.36	0.052 - 1.8	9/98	1.9	1/98
	VANADIUM	MG/KG	27.5	91.7	53.6	0.17	0.14 - 0.23	15.6	131	48.0	0.18	0.16 - 0.28	98/98	96	2/98
	ZINC	MG/KG	13.4	4,570	221	0.13	0.060 - 0.45	17.4	221	54.2	0.12	0.070 - 0.57	93/98	99	15/98
TPH EXTRACTABLES	DIESEL	MG/KG	15	18	21	40	10 - 560	ND	ND	ND	12	11 - 13	2/97	*	*
	MOTOR OIL	MG/KG	6	1,700	140	40	10 - 560	6	130	8	12	11 - 13	25/97	*	*
VOLATILES	1,1,1-TRICHLOROETHANE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	1,1,2,2-TETRACHLOROETHANE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	1,1,2-TRICHLOROETHANE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	1,1-DICHLOROETHANE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	1,1-DICHLOROETHENE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	1,2-DICHLOROETHANE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	1,2-DICHLOROETHENE (TOTAL)	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	1,2-DICHLOROPROPANE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	2-BUTANONE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	2-HEXANONE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	4-METHYL-2-PENTANONE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	ACETONE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	BENZENE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	BROMODICHLOROMETHANE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	BROMOFORM	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	BROMOMETHANE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	CARBON DISULFIDE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	CARBON TETRACHLORIDE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	CHLOROBENZENE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	CHLOROETHANE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	CHLOROFORM	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	CHLOROMETHANE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	CIS-1,3-DICHLOROPROPENE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	DIBROMOCHLOROMETHANE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	ETHYLBENZENE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	METHYLENE CHLORIDE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	STYRENE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	TETRACHLOROETHENE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*

ND = Not Detected

Ambient values for metals are in milligrams per kilogram (mg/kg).

The average was calculated using the detected values and 1/2 of the sample quantitation limit for nondetects.

Organic results less than 10 are reported to one significant figure, and results greater than 10 are reported to two significant figures.

Inorganic results less than 10 are reported to two significant figures, and results greater than 10 are reported to three significant figures.

\* Screening value not available

Surface samples are samples with bottom sample depth less than and equal to one foot. Subsurface samples are samples with bottom sample depth greater than one foot but less than four feet.

**Table 11-2 (Continued)**  
**Statistical Summary of Soil Analytical Results for Site 13**

Analysis	Analyte	Unit	Detected Results										Detection Frequency		
			Surface					Sub-Surface					Total	Ambient Values (MG/KG)	Above Ambient Values
			Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range	Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range			
VOLATILES	TOLUENE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	TRANS-1,3-DICHLOROPROPENE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	TRICHLOROETHENE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	VINYL CHLORIDE	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
	XYLENE (TOTAL)	UG/KG	ND	ND	ND	11	10 - 12	ND	ND	ND	12	11 - 18	0/46	*	*
LOW LEVEL SEMIVOLATILES	1,1'-BIPHENYL	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	1,2,4-TRICHLOROBENZENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	1,2-DICHLOROBENZENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	1,3-DICHLOROBENZENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	1,4-DICHLOROBENZENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	1-METHYLNAPHTHALENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	1-METHYLPHENANTHRENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	2,2'-OXYBIS (1-CHLOROPROPANE)	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	2,3,5-TRIMETHYLNAPHTHALENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	2,4,5-TRICHLOROPHENOL	UG/KG	ND	ND	ND	170	92 - 370	ND	ND	ND	270	89 - 660	0/16	*	*
	2,4,6-TRICHLOROPHENOL	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	2,4-DICHLOROPHENOL	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	2,4-DIMETHYLPHENOL	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	2,4-DINITROPHENOL	UG/KG	ND	ND	ND	230	92 - 540	ND	ND	ND	270	89 - 660	0/16	*	*
	2,4-DINITROTOLUENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	2,6-DIMETHYLNAPHTHALENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	2,6-DINITROTOLUENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	2-CHLORONAPHTHALENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	2-CHLOROPHENOL	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	2-METHYLNAPHTHALENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	2-METHYLPHENOL	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	2-NITROANILINE	UG/KG	ND	ND	ND	170	92 - 370	ND	ND	ND	270	89 - 660	0/16	*	*
	2-NITROPHENOL	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	3,3'-DICHLOROBENZIDINE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	3-NITROANILINE	UG/KG	ND	ND	ND	170	92 - 370	ND	ND	ND	270	89 - 660	0/16	*	*
	4,6-DINITRO-2-METHYLPHENOL	UG/KG	ND	ND	ND	170	92 - 370	ND	ND	ND	270	89 - 660	0/16	*	*
	4-BROMOPHENYL-PHENYLETHER	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	4-CHLORO-3-METHYLPHENOL	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	4-CHLOROANILINE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	4-CHLOROPHENYL-PHENYLETHER	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	4-METHYLPHENOL	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*
	4-NITROANILINE	UG/KG	ND	ND	ND	170	92 - 370	ND	ND	ND	270	89 - 660	0/16	*	*
	4-NITROPHENOL	UG/KG	ND	ND	ND	170	92 - 370	ND	ND	ND	270	89 - 660	0/16	*	*

ND = Not Detected

Ambient values for metals are in milligrams per kilogram (mg/kg).

The average was calculated using the detected values and 1/2 of the sample quantitation limit for nondetects.

Organic results less than 10 are reported to one significant figure, and results greater than 10 are reported to two significant figures.

Inorganic results less than 10 are reported to two significant figures, and results greater than 10 are reported to three significant figures.

\* Screening value not available

Surface samples are samples with bottom sample depth less than and equal to one foot. Subsurface samples are samples with bottom sample depth greater than one foot but less than four feet.

Table 11-2 (Continued)

## Statistical Summary of Soil Analytical Results for Site 13

Analysis	Analyte	Unit	Detected Results											Detection Frequency		
			Surface					Sub-Surface						Total	Ambient Values (NG/TC)	Above Ambient Values
			Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range	Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range				
LOW LEVEL SEMIVOLATILES	ACENAPHTHENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	ACENAPHTHYLENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	ANTHRACENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	BENZO (A) ANTHRACENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	BENZO (A) PYRENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	BENZO (B) FLUORANTHENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	BENZO (E) PYRENE	UG/KG	ND	ND	ND	69	37 - 150	21	21	49	110	36 - 260	1/16	*	*	
	BENZO (G, H, I) PERYLENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	BENZO (K) FLUORANTHENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	BENZOIC ACID	UG/KG	14	21	66	170	92 - 370	16	26	120	270	89 - 660	5/16	*	*	
	BENZYL ALCOHOL	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	BIS (2-CHLOROETHOXY) METHANE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	BIS (2-CHLOROETHYL) ETHER	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	BIS (2-ETHYLHEXYL) PHTHALATE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	BUTYLBENZYL PHTHALATE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	CARBAZOLE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	CHRYSENE	UG/KG	17	17	34	69	37 - 150	15	15	48	110	36 - 260	2/16	*	*	
	DI-N-BUTYL PHTHALATE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	DI-N-OCTYL PHTHALATE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	DIBENZ (A, H) ANTHRACENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	DIBENZOFURAN	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	DIBENZOTHIOPHENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	DIETHYL PHTHALATE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	DIMETHYL PHTHALATE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	FLUORANTHENE	UG/KG	ND	ND	ND	69	37 - 150	6	6	52	110	36 - 260	1/16	*	*	
	FLUORENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	HEXACHLOROBENZENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	HEXACHLOROBUTADIENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	HEXACHLOROCYCLOPENTADIENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	HEXACHLOROCETHANE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	HIGH MOLECULAR PAHs	UG/KG	17	17	3			12	36	5			3/16	*	*	
	INDENO (1, 2, 3-CD) PYRENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	ISOPHORONE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	LOW MOLECULAR PAHs	UG/KG	ND	ND	ND	ND		ND	ND	ND			0/16	*	*	
	N-NITROSO-DI-N-PROPYLAMINE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	N-NITROSODIPHENYLAMINE (1)	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	NAPHTHALENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	
	NITROBENZENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 260	0/16	*	*	

ND = Not Detected

Ambient values for metals are in milligrams per kilogram (mg/kg).

The average was calculated using the detected values and % of the sample quantitation limit for nondetects.

Organic results less than 10 are reported to one significant figure, and results greater than 10 are reported to two significant figures.

Inorganic results less than 10 are reported to two significant figures, and results greater than 10 are reported to three significant figures.

\* Screening value not available

Surface samples are samples with bottom sample depth less than and equal to one foot. Subsurface samples are samples with bottom sample depth greater than one foot but less than four feet.

Table 11-2 (Continued)

## Statistical Summary of Soil Analytical Results for Site 13

Analysis	Analyte	Unit	Detected Results										Detection Frequency		
			Surface					Sub-Surface							
			Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range	Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range	Total	Ambient Values (MG/KG)	Above Ambient Values
LOW LEVEL SEMIVOLATILES	PENTACHLOROPHENOL	UG/KG	ND	ND	ND	170	92 - 370	ND	ND	ND	270	89 - 560	0/16	*	*
	PERYLENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 250	0/16	*	*
	PHENANTHRENE	UG/KG	ND	ND	ND	69	37 - 150	ND	ND	ND	110	36 - 250	0/16	*	*
	PHENOL	UG/KG	230	740	300	69	37 - 150	87	1,900	460	110	36 - 250	11/16	*	*
	PYRENE	UG/KG	ND	ND	ND	69	37 - 150	6	6	52	110	36 - 250	1/16	*	*
	TOTAL PAHs	UG/KG	17	17	3			12	36	5			3/16	*	*

ND = Not Detected

Ambient values for metals are in milligrams per kilogram (mg/kg).

The average was calculated using the detected values and 1/2 of the sample quantitation limit for nondetects.

Organic results less than 10 are reported to one significant figure, and results greater than 10 are reported to two significant figures.

Inorganic results less than 10 are reported to two significant figures, and results greater than 10 are reported to three significant figures.

\* Screening value not available

Surface samples are samples with bottom sample depth less than and equal to one foot. Subsurface samples are samples with bottom sample depth greater than one foot but less than four feet.

Table 11-3

## Statistical Summary of Sediment Analytical Results for Site 17

Analysis	Analyte	Unit	Detected Results										Detection Frequency		
			Surface					Sub-Surface					Total	Ambient Values (MG/KG)	Above Ambient Values
			Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range	Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range			
HEXAVALENT CHROMIUM	HEXAVALENT CHROMIUM	UG/KG	ND	ND	ND	66.0	66.0 - 66.0	ND	ND	ND	53.0	53.0 - 53.0	0/2	*	*
SEMI-VOLATILES <sup>6</sup>	1,2,4-TRICHLOROBENZENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	1,2-DICHLOROBENZENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	1,3-DICHLOROBENZENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	1,4-DICHLOROBENZENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	2,2'-OXYBIS(1-CHLOROPROPANE)	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	2,4,5-TRICHLOROPHENOL	UG/KG	ND	ND	ND	1,000	910 - 1,100	ND	ND	ND	8,500	8,500 - 8,500	0/4	*	*
	2,4,6-TRICHLOROPHENOL	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	2,4-DICHLOROPHENOL	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	2,4-DIMETHYLPHENOL	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	2,4-DINITROPHENOL	UG/KG	ND	ND	ND	1,000	910 - 1,100	ND	ND	ND	8,500	8,500 - 8,500	0/4	*	*
	2,4-DINITROTOLUENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	2,6-DINITROTOLUENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	2-CHLORONAPHTHALENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	2-CHLOROPHENOL	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	2-METHYLNAPHTHALENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	2-METHYLPHENOL	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	2-NITROANILINE	UG/KG	ND	ND	ND	1,000	910 - 1,100	ND	ND	ND	8,500	8,500 - 8,500	0/4	*	*
	2-NITROPHENOL	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	3,3'-DICHLOROBENZIDINE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	3-NITROANILINE	UG/KG	ND	ND	ND	1,000	910 - 1,100	ND	ND	ND	8,500	8,500 - 8,500	0/4	*	*
	4,6-DINITRO-2-METHYLPHENOL	UG/KG	ND	ND	ND	1,000	910 - 1,100	ND	ND	ND	8,500	8,500 - 8,500	0/4	*	*
	4-BROMOPHENYL-PHENYLETHER	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	4-CHLORO-3-METHYLPHENOL	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	4-CHLOROANILINE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	4-CHLOROPHENYL-PHENYLETHER	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	4-METHYLPHENOL	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	4-NITROANILINE	UG/KG	ND	ND	ND	1,000	910 - 1,100	ND	ND	ND	8,500	8,500 - 8,500	0/4	*	*
	4-NITROPHENOL	UG/KG	ND	ND	ND	1,000	910 - 1,100	ND	ND	ND	8,500	8,500 - 8,500	0/4	*	*
	ACENAPHTHENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	ACENAPHTHYLENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	ANTHRACENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	BENZO(A)ANTHRACENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	BENZO(A)PYRENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	BENZO(B)FLUORANTHENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	BENZO(G,H,I)PERYLENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	BENZO(K)FLUORANTHENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*
	EIS(2-CHLOROETHOXY)METHANE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	0/4	*	*

ND = Not Detected

Ambient values for metals are in milligrams per kilogram (mg/kg).

The average was calculated using the detected values and % of the sample quantitation limit for nondetects.

Organic results less than 10 are reported to one significant figure, and results greater than 10 are reported to two significant figures.

Inorganic results less than 10 are reported to two significant figures, and results greater than 10 are reported to three significant figures.

\* Screening value not available

Surface samples are samples with bottom sample depth less than and equal to one foot. Subsurface samples are samples with bottom sample depth greater than one foot but less than four feet.

<sup>6</sup> SVOCs analyses were done using the regular CLP methodology. No Low detection limit SVOCs were analyzed for sediment samples



Table 11-3 (Continued)

## Statistical Summary of Sediment Analytical Results for Site 17

Analysis	Analyte	Unit	Detected Results										Detection Frequency		
			Surface					Sub-Surface					Total	Ambient Values (MG/KG)	Above Ambient Values
			Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range	Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range			
SEMIVOLATILES <sup>6</sup>	BIS (2-CHLOROETHYL) ETHER	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	BIS (2-ETHYLHEXYL) PHTHALATE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	BUTYLBENZYLPHthalATE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	CARBAZOLE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	CHRYSENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	DI-N-BUTYLPHthalATE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	DI-N-OCTYLPHthalATE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	DIBENZ (A, H) ANTHRACENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	DIBENZOFURAN	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	DISTHYLPHTHALATE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	DIMETHYLPHTHALATE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	FLUORANTHENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	FLUORENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	HEXACHLOROBENZENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	HEXACHLOROCYCLOPENTADIENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	HEXACHLOROCYCLOPENTADIENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	HEXACHLOROCETHANE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	HIGH MOLECULAR PAHs	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	INDENO (1,2,3-CD) PYRENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	ISOPHORONE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
	LOW MOLECULAR PAHs	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*
N-NITROSO-DI-N-PROPYLAMINE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*	
N-NITROSO-DIPHENYLAMINE (1)	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*	
NAPHTHALENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*	
NITROBENZENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*	
PENTACHLOROPHENOL	UG/KG	ND	ND	ND	1,000	910 - 1,100	ND	ND	ND	8,500	8,500 - 8,500	C/4	*	*	
PHENANTHRENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*	
PHENOL	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*	
PYRENE	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*	
TOTAL PAHs	UG/KG	ND	ND	ND	420	380 - 440	ND	ND	ND	3,500	3,500 - 3,500	C/4	*	*	
TOTAL METALS	ALUMINUM	MG/KG	11,700	15,000	13,300	1.7	1.6 - 1.9	11,400	11,400	11,400	0.99	0.99 - 0.99	4/4	20000	0/4
	ANTIMONY	MG/KG	ND	ND	ND	0.43	0.39 - 0.47	ND	ND	ND	0.24	0.24 - 0.24	0/4	1.2	0/4
	ARSENIC	MG/KG	4.8	5.7	5.2	0.51	0.46 - 0.56	2.0	2.0	2.0	0.29	0.29 - 0.29	4/4	7.3	0/4
	BARIUM	MG/KG	135	153	144	0.41	0.37 - 0.45	62.0	62.0	62.0	0.23	0.23 - 0.23	4/4	210	0/4
	BERYLLIUM	MG/KG	0.30	0.40	0.36	0.0080	0.0070-0.0090	0.13	0.13	0.13	0.0050	0.0050-0.0050	4/4	0.56	0/4
	CADMIUM	MG/KG	ND	ND	ND	0.041	0.037 - 0.045	ND	ND	ND	0.023	0.023 - 0.023	0/4	0.15	0/4
	CALCIUM	MG/KG	5,320	6,370	5,820	11.5	10.4 - 12.7	5,800	5,800	5,800	6.5	6.5 - 6.5	4/4	*	*
	CHROMIUM	MG/KG	30.3	35.4	32.4	0.16	0.15 - 0.18	34.1	34.1	34.1	0.093	0.093 - 0.093	4/4	55	0/4

ND = Not Detected

Ambient values for metals are in milligrams per kilogram (mg/kg).

The average was calculated using the detected values and 1/2 of the sample quantitation limit for nondetects.

Organic results less than 10 are reported to one significant figure, and results greater than 10 are reported to two significant figures.

Inorganic results less than 10 are reported to two significant figures, and results greater than 10 are reported to three significant figures.

\* Screening value not available

Surface samples are samples with bottom sample depth less than and equal to one foot. Subsurface samples are samples with bottom sample depth greater than one foot but less than four feet.

<sup>6</sup> SVOCs analyses were done using the regular CLP methodology. No Low detection limit SVOCs were analyzed for sediment samples

Table 11-3 (Continued)

## Statistical Summary of Sediment Analytical Results for Site 17

Analysis	Analyte	Unit	Detected Results										Detection Frequency		
			Surface					Sub-Surface							
			Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range	Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range	Total	Ambient Values (MG/KG)	Above Ambient Values
TOTAL METALS	COBALT	MG/KG	13.8	15.8	14.9	0.22	0.20 - 0.25	15.1	15.1	15.1	0.13	0.13 - 0.13	4/4	24	0/4
	COPPER	MG/KG	31.8	36.4	34.7	0.22	0.20 - 0.25	44.3	44.3	44.3	0.13	0.13 - 0.13	4/4	64	0/4
	IRON	MG/KG	24,200	28,400	25,800	5.0	4.5 - 5.5	23,900	23,900	23,900	2.6	2.8 - 2.8	4/4	*	*
	LEAD	MG/KG	10.0	15.4	11.9	0.31	0.28 - 0.34	5.4	9.4	9.4	0.17	0.17 - 0.17	4/4	18	0/4
	MAGNESIUM	MG/KG	6,590	8,070	7,290	9.6	8.6 - 10.6	9,190	9,190	9,190	5.4	5.4 - 5.4	4/4	*	*
	MANGANESE	MG/KG	519	646	577	0.041	0.037 - 0.045	388	388	388	0.023	0.023 - 0.023	4/4	870	0/4
	MERCURY	MG/KG	ND	ND	ND	0.014	0.012 - 0.018	ND	ND	ND	0.015	0.015 - 0.015	0/4	0.14	0/4
	MOLYBDENUM	MG/KG	ND	ND	ND	0.18	0.17 - 0.20	1.1	1.1	1.1	0.10	0.10 - 0.10	1/4	*	*
	NICKEL	MG/KG	48.7	54.1	51.3	0.33	0.30 - 0.36	59.0	59.0	59.0	0.19	0.19 - 0.19	4/4	86	0/4
	POTASSIUM	MG/KG	1,360	1,830	1,670	9.8	8.9 - 10.9	555	555	555	5.6	5.6 - 5.6	4/4	*	*
	SELENIUM	MG/KG	ND	ND	ND	0.61	0.55 - 0.68	ND	ND	ND	0.35	0.35 - 0.35	0/4	*	*
	SILVER	MG/KG	ND	ND	ND	0.24	0.22 - 0.27	ND	ND	ND	0.14	0.14 - 0.14	0/4	*	*
	SODIUM	MG/KG	ND	ND	ND	73.4	66.4 - 81.2	ND	ND	ND	41.8	41.8 - 41.8	0/4	*	*
	THALLIUM	MG/KG	0.14	0.21	0.16	0.071	0.050 - 0.082	0.14	0.14	0.14	0.055	0.055 - 0.055	4/4	*	*
VANADIUM	MG/KG	53.1	62.9	55.5	0.22	0.20 - 0.25	47.6	47.6	47.6	0.13	0.13 - 0.13	4/4	86	0/4	
ZINC	MG/KG	63.7	81.2	71.3	0.33	0.30 - 0.36	78.3	78.3	78.3	0.19	0.19 - 0.19	4/4	83	0/4	
TPH EXTRACTABLES	DIESEL	MG/KG	ND	ND	ND	23	13 - 28	ND	ND	ND	1,100	1,100 - 1,100	0/4	*	*
	MOTOR OIL	MG/KG	110	180	150	23	13 - 28	4,100	4,100	4,100	1,100	1,100 - 1,100	4/4	*	*
TPH PURGEABLES	GASOLINE	MG/KG	ND	ND	ND	0.5	0.5 - 0.5	ND	ND	ND	0.3	0.3 - 0.3	0/2	*	*
VOLATILES	1,1,1-TRICHLOROETHANE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	1,1,1,2-TETRACHLOROETHANE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	1,1,2-TRICHLOROETHANE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	1,1-DICHLOROETHANE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	1,1-DICHLOROETHENE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	1,2-DICHLOROETHANE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	1,2-DICHLOROETHENE (TOTAL)	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	1,2-DICHLOROPROPANE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	2-BUTANONE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	2-HEXANONE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	4-METHYL-2-PENTANONE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	ACETONE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	BENZENE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	BROMODICHLOROMETHANE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	BROMOFORM	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	BROMOMETHANE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	CARBON DISULFIDE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	CARBON TETRACHLORIDE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*

ND = Not Detected

Ambient values for metals are in milligrams per kilogram (mg/kg).

The average was calculated using the detected values and 1/2 of the sample quantitation limit for nondetects.

Organic results less than 10 are reported to one significant figure, and results greater than 10 are reported to two significant figures.

Inorganic results less than 10 are reported to two significant figures, and results greater than 10 are reported to three significant figures.

\* Screening value not available

Surface samples are samples with bottom sample depth less than and equal to one foot. Subsurface samples are samples with bottom sample depth greater than one foot but less than four feet.

SVOCs analyses were done using the regular CLP methodology. No low detection limit SVOCs were analyzed for sediment samples



Table 11-3 (Continued)

## Statistical Summary of Sediment Analytical Results for Site 17

Analysis	Analyte	Unit	Detected Results										Detection Frequency		
			Surface					Sub-Surface					Total	Ambient Values (MG/KG)	Above Ambient Values
			Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range	Minimum	Maximum	Average	Detection Limit Average	Detection Limit Range			
VOLATILES	CHLOROBENZENE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	CHLOROETHANE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	CHLOROFORM	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	CHLOROMETHANE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	CIS-1,3-DICHLOROPROPENE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	DIBROMOCHLOROMETHANE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	ETHYLBENZENE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	METHYLENE CHLORIDE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	STYRENE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	TETRACHLOROETHENE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	TOLUENE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	TRANS-1,3-DICHLOROPROPENE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	TRICHLOROETHENE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	VINYL CHLORIDE	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*
	XYLENE (TOTAL)	UG/KG	NA	NA	NA	NA	NA	ND	ND	ND	11	11 - 11	0/1	*	*

ND = Not Detected

Ambient values for metals are in milligrams per kilogram (mg/kg).

The average was calculated using the detected values and % of the sample quantitation limit for nondetects.

Organic results less than 10 are reported to one significant figure, and results greater than 10 are reported to two significant figures.

Inorganic results less than 10 are reported to two significant figures, and results greater than 10 are reported to three significant figures.

\* Screening value not available

Surface samples are samples with bottom sample depth less than and equal to one foot. Subsurface samples are samples with bottom sample depth greater than one foot but less than four feet.

TABLE 11-4

**SCREENING VALUES USED IN THE IDENTIFICATION  
OF COECS AT SITES 13 AND 17**

Chemical	Ambient (mg/kg) <sup>a</sup>		Chronic AWQC (ug/L)	ER-L <sup>b</sup> (mg/kg)	ER-M <sup>b</sup> (mg/kg)
	Site 13 Soil	Site 17 Sediment			
Aluminum	21000	20000	*	*	*
Antimony	0.9	1.2	1600	2	25
Arsenic	10	7.3	190	8.2	70
Barium	560	210	*	*	*
Beryllium	0.12	0.56	5.3	*	*
Cadmium	0.29	0.15	1.1	1.2	9.6
Chromium	62	55	*	81	370
Cobalt	24	24	*	*	*
Copper	65	64	12	34	270
Iron	*	*	1000	*	*
Lead	33	18	3.2	46.7	218
Manganese	1200	870	*	*	*
Mercury	0.17	0.14	0.12	0.15	0.71
Nickel	100	86	160	20.9	51.6
Selenium	*	*	5	0.7	1.4
Silver	*	*	*	1	3.7
Thallium	1.9	*	40	*	*
Vanadium	96	86	*	*	*
Zinc	99	83	110	150	410

<sup>a</sup> Values as listed in Appendix A

<sup>b</sup> Long and others (1995)

\* Screening values not available

ER-L = Effects Range - Low

ER-M = Effects Range - Median

AWQC = Ambient Water Quality Criteria

COEC = Chemical of Ecological Concern

mg/kg = milligrams per kilogram

ug/L = micrograms per liter

TABLE 11-5

COMPARISON OF TOTAL INORGANIC CONCENTRATIONS IN BULK SOIL AND  
WET-DI AT SITE 13 - ALUMINUM AND ARSENIC

	Total Al	WET Al	Total As	WET As
Sample size (N)	25	25	25	25
Non-detects	0	1	2	8
Minimum	6660.0000	0.1940	1.7000	0.0014
Maximum	28900.0000	8.3900	8.6000	0.0058
Std error	1026.1641	0.4591	0.3289	0.0003
C.V.	36.0280	83.3189	35.6335	44.2653
Mean	14241.2000	2.6992	4.4261	0.0027
Geometric mean	13415.0140	1.6665	4.1549	0.0025
Quadratic mean	15102.4529	3.4833	4.6872	0.0030
Harmonic mean	12643.6253	0.8171	3.8768	0.0024
Median	13300.0000	2.2700	4.3000	0.0022
Quartiles				
First quartile	10650.0000	1.0097	3.1000	0.0019
Second quartile	13300.0000	2.2700	4.3000	0.0022
Third quartile	17800.0000	4.2500	5.5000	0.0032
95.00% Confidence Interval				
Lower limit	12123.3014	1.7496	3.7441	0.0021
Upper limit	16359.0986	3.6489	5.1081	0.0034

WET = Waste extraction test

DI = Dionized water

C.V. = Coefficient of variability

Al = Aluminum

As = Arsenic

\* Concentrations are in mg/kg.

TABLE 11-5 (Continued)

**COMPARISON OF TOTAL INORGANIC CONCENTRATIONS IN BULK SOIL AND  
WET-DI AT SITE 13 - BARIUM AND CALCIUM**

	Total Ba	WET Ba	Total Ca	WET Ca
Sample size (N)	25	25	25	25
Non-detects	0	0	0	0
Minimum	103.0000	0.0250	2100.0000	3.9700
Maximum	1670.0000	3.5700	7770.0000	100.0000
Std error	68.4233	0.1909	320.4673	3.8567
C.V.	84.4649	146.5055	32.5731	147.1636
Mean	405.0400	0.6515	4919.2000	13.1036
Geometric mean	318.8770	0.3142	4636.2552	9.0256
Quadratic mean	525.7561	1.1398	5163.6530	22.9933
Harmonic mean	261.6586	0.1647	4328.7012	7.6124
Median	272.0000	0.3470	5410.0000	8.7400
<b>Quartiles:</b>				
First quartile	227.0000	0.1190	3535.0000	5.3450
Second quartile	272.0000	0.3470	5410.0000	8.7400
Third quartile	500.0000	0.5645	6380.0000	11.3500
<b>95.00% Confidence Interval</b>				
Lower limit	263.8212	0.2575	4257.7879	5.1437
Upper limit	546.2588	1.0455	5580.6121	21.0635

WET = Waste extraction test

DI = Dionized water

C.V. = Coefficient of variability

Ba = Barium

Ca = Calcium

\* Concentrations are in mg/kg.

TABLE 11-5 (Continued)

COMPARISON OF TOTAL INORGANIC CONCENTRATIONS IN BULK SOIL AND  
WET-DI AT SITE 13 - CHROMIUM AND COBALT

	Total Cr	WET Cr	Total Co	WET Co
Sample size (N)	25	25	25	25
Non-detects	0	21	0	18
Minimum	18.0000	0.0010	5.5000	0.0010
Maximum	64.6000	0.0157	31.3000	0.0036
Std error	2.6741	0.0034	1.0356	0.0003
C.V.	37.9845	111.1355	32.8887	38.7864
Mean	35.2000	0.0061	15.7440	0.0023
Geometric mean	32.8993	0.0036	14.9212	0.0022
Quadratic mean	37.5588	0.0084	16.5412	0.0025
Harmonic mean	30.8188	0.0022	14.0160	0.0020
Median	32.7000	0.0038	15.0000	0.0020
Quartiles				
First quartile	23.0500	0.0016	12.7500	0.0018
Second quartile	32.7000	0.0038	15.0000	0.0020
Third quartile	46.5500	0.0083	17.8000	0.0030
95.00% Confidence Interval				
Lower limit	29.6809	-0.0047	13.6066	0.0015
Upper limit	40.7191	0.0168	17.8814	0.0032

WET = Waste extraction test

DI = Dionized water

C.V. = Coefficient of variability

Cr = Chromium

Co = Cobalt

\* Concentrations are in mg/kg.

TABLE 11-5 (Continued)

COMPARISON OF TOTAL INORGANIC CONCENTRATIONS IN BULK SOIL AND  
WET-DI AT SITE 13 - MANGANESE AND MERCURY

	Total Mn	WET Mn	Total Hg	WET Hg
Sample size (N)	25	25	25	25
Non-detects	0	3	14	15
Minimum	143.0000	0.0044	0.0050	0.0001
Maximum	1450.0000	0.1420	0.3200	0.0070
Std error	61.9569	0.0087	0.0277	0.0008
C.V.	45.4043	67.6766	68.1119	169.1130
Mean	682.2300	0.0604	0.1350	0.0015
Geometric mean	611.3352	0.0447	0.0960	0.0004
Quadratic mean	746.7487	0.0724	0.1610	0.0028
Harmonic mean	528.4259	0.0274	0.0382	0.0002
Median	650.0000	0.0555	0.1000	0.0002
Quartiles				
First quartile	504.5000	0.0254	0.0700	0.0002
Second quartile	650.0000	0.0555	0.1000	0.0002
Third quartile	788.5000	0.0855	0.2000	0.0010
95.00% Confidence Interval				
Lower limit	554.4073	0.0423	0.0732	-0.0003
Upper limit	810.1527	0.0785	0.1968	0.0032

WET = Waste extraction test

DI = Dionized water

C.V. = Coefficient of variability

Mn = Manganese

Hg = Mercury

\* Concentrations are in mg/kg.

TABLE 11-5 (Continued)

COMPARISON OF TOTAL INORGANIC CONCENTRATIONS IN BULK SOIL AND  
WET-DI AT SITE 13 - COPPER AND IRON

	Total Cu	WET Cu	Total Fe	WET Fe
Sample size (N)	25	25	25	25
Non-detects	0	6	0	4
Minimum	11.4000	0.0030	8740.0000	0.1170
Maximum	355.0000	0.0600	30800.0000	83.8000
Std error	13.2311	0.0037	1392.3921	3.9244
C.V.	151.3577	92.7090	34.2927	324.6744
Mean	43.7080	0.0174	20301.6000	5.5390
Geometric mean	31.4155	0.0126	19055.8517	1.2845
Quadratic mean	78.1784	0.0234	21416.9350	18.4036
Harmonic mean	27.3219	0.0092	17768.3917	0.6109
Median	28.6000	0.0124	21300.0000	0.9390
Quartiles:				
First quartile	21.0000	0.0079	14100.0000	0.5765
Second quartile	28.6000	0.0124	21300.0000	0.9390
Third quartile	37.7500	0.0208	26950.0000	3.1600
95.00% Confidence Interval:				
Lower limit	16.4004	0.0096	17427.8439	-2.6471
Upper limit	71.0156	0.0252	23175.3561	13.7251

WET = Waste extraction test

DI = Dionized water

C.V. = Coefficient of variability

Cu = Copper

Fe = Iron

\* Concentrations are in mg/kg.

TABLE 11-5 (Continued)

COMPARISON OF TOTAL INORGANIC CONCENTRATIONS IN BULK SOIL AND  
WET-DI AT SITE 13 - LEAD AND MAGNESIUM

	Total Pb	WET Pb	Total Mg	WET Mg
Sample size (N)	25	25	25	25
Non-detects	3	18	0	0
Minimum	4.5000	0.0055	1730.0000	3.1500
Maximum	467.0000	0.0269	13500.0000	30.6000
Std error	24.2692	0.0029	506.7770	1.3516
C.V.	225.6141	51.9906	41.1398	85.1666
Mean	50.4545	0.0148	6159.2000	7.9352
Geometric mean	14.7653	0.0130	5669.8777	6.4479
Quadratic mean	122.1250	0.0165	6640.7451	10.3350
Harmonic mean	9.7114	0.0113	5152.1311	5.6663
Median	9.7000	0.0140	5630.0000	5.6000
Quartiles				
First quartile	6.9500	0.0090	4140.0000	4.2800
Second quartile	9.7000	0.0140	5630.0000	5.6000
Third quartile	14.8250	0.0197	7530.0000	7.5150
95.00% Confidence Interval				
Lower limit	-0.0160	0.0077	5113.2636	5.1456
Upper limit	100.9251	0.0220	7205.1364	10.7248

WET = Waste extraction test

DI = Dionized water

C.V. = Coefficient of variability

Pb = Lead

Mg = Magnesium

\* Concentrations are in mg/kg.



TABLE 11-5 (Continued)

COMPARISON OF TOTAL INORGANIC CONCENTRATIONS IN BULK SOIL AND  
WET-DI AT SITE 13 - NICKEL AND POTASSIUM

	Total Ni	WET Ni	Total K	WET K
Sample size (N)	25	25	25	25
Non-detects	0	15	2	2
Minimum	14.3000	0.0030	134.0000	0.0858
Maximum	117.0000	3.2800	2310.0000	3.3200
Std error	4.2129	0.3263	117.5171	0.1992
C.V.	39.1471	300.3898	54.5106	112.9464
Mean	53.8080	0.3435	1033.9130	0.8459
Geometric mean	49.8494	0.0233	876.0476	0.5071
Quadratic mean	57.6303	1.0374	1171.6663	1.2604
Harmonic mean	45.3476	0.0108	685.0715	0.3343
Median	53.6000	0.0158	911.0000	0.4410
Quartiles				
First quartile	38.6500	0.0132	656.0000	0.2410
Second quartile	53.6000	0.0158	911.0000	0.4410
Third quartile	61.700	0.0304	1430.0000	0.7820
95.00% Confidence Interval				
Lower limit	45.1131	-0.3946	790.1976	0.4328
Upper limit	62.5029	1.0816	1277.6285	1.2591

WET = Waste extraction test

DI = Dionized water

C.V. = Coefficient of variability

Ni = Nickel

K = Potassium

\* Concentrations are in mg/kg.

TABLE 11-5 (Continued)

COMPARISON OF TOTAL INORGANIC CONCENTRATIONS IN BULK SOIL AND  
WET-DI AT SITE 13 - VANADIUM AND ZINC

	Total V	WET V	Total Zn	WET Zn
Sample size (N)	25	25	25	25
Non-detects	0	1	4	4
Minimum	26.6000	0.0050	13.4000	0.0043
Maximum	488.8000	0.6860	1340.0000	1.5400
Std error	17.8109	0.0356	64.4205	0.1027
C.V.	127.5195	204.6675	226.2242	223.2327
Mean	69.8360	0.0852	130.4952	0.2108
Geometric mean	54.1443	0.0267	55.4452	0.0296
Quadratic mean	111.7611	0.1907	316.2736	0.5053
Harmonic mean	48.2241	0.0164	40.1215	0.0136
Median	53.0000	0.0179	50.2000	0.0154
Quartiles				
First quartile	34.9500	0.0129	29.3500	0.0087
Second quartile	53.0000	0.0179	50.2000	0.0154
Third quartile	67.2000	0.0312	62.7500	0.0527
95.00% Confidence interval...				
Lower limit	33.0761	0.0116	-3.8835	-0.0034
Upper limit	106.5959	0.1588	264.8740	0.4250

WET = Waste extraction test

DI = Dionized water

C.V. = Coefficient of variability

V = Vanadium

Zn = Zinc

\* Concentrations are in mg/kg.

TABLE 11-5 (Continued)

COMPARISON OF TOTAL INORGANIC CONCENTRATIONS IN BULK SOIL AND  
WET-DI AT SITE 13 - SODIUM AND THALLIUM

	Total Na	WET Na	Total Tl	WET Tl
Sample size (N)	10	10	10	10
Non-detects	4	0	9	10
Minimum	107.0000	0.3220	0.8100	0.8100
Maximum	591.0000	10.7000	0.8100	0.0000
Std error	79.4220	1.1242	NaN	NaN
C.V.	64.0999	85.8018	NaN	NaN
Mean	303.5000	4.1432	0.8100	NaN
Geometric mean	253.0199	2.7853	0.8100	NaN
Quadratic mean	351.6412	5.3423	0.8100	NaN
Harmonic mean	211.5702	1.5694	0.8100	NaN
Median	247.0000	3.1500	0.8100	0.4050
Quartiles				
First quartile	159.7500	2.0050	0.8100	0.0000
Second quartile	247.0000	3.1500	0.8100	0.0000
Third quartile	435.5000	4.7300	0.8100	0.0000
95.00% Confidence Interval				
Lower limit	99.3393	1.6001	NaN	NaN
Upper limit	507.6607	6.6863	NaN	NaN

WET = Waste extraction test

DI = Dionized water

C.V. = Coefficient of variability

Na = Sodium

Tl = Thallium

\* Concentrations are in mg/kg.

TABLE 11-6

**WET METALS DATA SUMMARY FOR SURFACE SOIL AND  
SEDIMENT SAMPLES (SEAL CREEK)**

Metal	Measured Concentrations (ug/L)				AWQC (ug/L)
	ACSSB028	ACSSB029	ACSSB030	ACSSB031	Chronic <sup>a</sup>
Aluminum	1390	354	271	607	*
Antimony	2.1	*	*	*	1600
Arsenic	2.5	*	*	*	190
Barium	693	986	898	589	*
Beryllium	0.04	*	*	*	5.3
Cadmium	0.25	*	*	*	1.1
Calcium	2810	18100	15300	10100	*
Chromium	11.6	*	*	*	*
Cobalt	2	1.7	2.4	*	*
Copper	38.7	10.7	5.4	5.7	12
Iron	2290	215	207	736	1000
Lead	6	2.6	2.4	*	3.2
Magnesium	1430	8300	6970	4500	*
Manganese	111	104	336	6.7	*
Mercury	0.2	*	*	*	0.012
Molybdenum	2.5	*	*	*	*
Nickel	18.4	5.2	9.1	6.5	160
Potassium	3280	1590	1760	461	*
Selenium	3	*	*	*	5
Silver	1.2	*	*	*	0.12
Sodium	7820	8430	7610	5610	*
Thallium	0.3	*	*	*	40
Vanadium	8.6	4.1	3.3	5	*
Zinc	542	638	535	45.9	110

<sup>a</sup> U.S. EPA Ambient Water Quality Criteria (AWQC) Freshwater Chronic values, 1995.

ug/L = Micrograms per liter

Note: Three randomly-selected soil samples were extracted using WET-DI. They are 2 subsurface samples from ASCMW013 and 1 surface sample from ACSSB028. Only sample ACSSB028 was considered in the ecological assessment because the others were distant from Seal Creek.

TABLE 11-7  
SUMMARY RESULTS: MICROTOX AND COMPREHENSIVE SOIL SURVEY<sup>1</sup> FROM BURN AREA

Sample location	Texture	pH	CEC	Nitrate-N	Phosphorus	Potassium	Calcium	Magnesium	Sodium	Zinc	Manganese	Iron	Copper	Boron	Chloride	Sulfate-S	Soil salinity	Solid-phase Microtox	Percent solids	Percent moisture
BUASS100	Silt Loam	5.8	32	2.0	5.0	190.0	1.2	1.4	0.7	1.0	51.0	46.0	2.6	0.11	0.1	0.8	0.3	8.3	85.5	17.0
BUASS101	Silt Loam	5.5	21	2.6	5.0	170.0	1.5	1.4	0.7	3.2	76.0	100.0	4.2	0.13	0.2	0.8	0.3	9.0	91.2	9.8
BUASS102	Silt Loam	5.3	27	2.0	5.0	210.0	1.4	1.6	1.0	2.0	58.0	99.0	3.5	0.15	0.2	0.8	0.4	8.7	88.5	12.0
BUASS212	Silt Loam	5.9	31	0.0	5.0	230.0	1.7	1.1	0.8	0.7	14.0	30.0	2.0	0.11	0.1	0.5	0.3	2.3	85.5	18.0
BUASS214	Silt Loam	5.4	31	1.0	5.0	150.0	0.7	0.8	1.9	0.5	21.0	58.0	3.2	0.15	0.3	0.6	0.4 0.2	1.9	86.4	21.0
BUASS216	Silt Loam	6.7	31	2.8	15.0	190.0	4.0	2.3	0.6	2.6	13.0	16.0	1.6	0.06	0.1	0.5	0.5	1.3	85.4	13.0
BUASS218	Silt Loam	5.3	26	2.1	5.0	170.0	0.9	1.2	1.2	1.6	77.0	76.0	4.1	0.12	0.3	0.7	0.3	1.9	92.4	14.0
BUASS224	Silt Loam	5.5	35	2.9	5.0	160.0	0.7	0.7	1.0	0.9	48.0	53.0	3.6	0.11	0.2	0.6	0.2	0.8	82.7	21.0
BUASS204	Silt Loam	6.8	40	1.6	5.0	110.0	3.2	1.6	0.5	0.4	8.6	13.0	1.5	0.12	0.1	0.4		0.6	77.5	21.0
BUASS178	Clay Loam	5.6	33	1.0	6.0	140.0	1.0	0.9	0.9	0.9	49.0	42.0	2.7	0.10	0.1	0.7	0.3	1.3	84.4	18.0

<sup>1</sup>pH in units

Cation Exchange Capacity (CEC) in mEq/100 gm

Nitrate-N, Phosphorus, Potassium, Zinc, Manganese, Iron, Copper, Boron in parts per million (ppm); either mg/kg or mg/L depending on analyte)

Calcium, Magnesium, Sodium, Chloride, Sulfate-S in meq/L

Soil salinity in mmhos/cm<sup>2</sup>

Microtox in percent soil associated with EC<sub>10</sub> (percent soil associated with median concentration yielding 50% reduction in light output)

**TABLE 11-8****EXPOSURE PARAMETERS FOR REPRESENTATIVE TERRESTRIAL RECEPTORS**

<b>Representative Species <sup>1</sup></b>	<b>Plant material consumed (kg/day)</b>	<b>Animal material consumed (kg/day)</b>	<b>Soil consumed <sup>2</sup> (kg/day)</b>	<b>Trophic transfer coefficient <sup>3</sup> (dose fraction)</b>	<b>Exposure Frequency (days/year)</b>	<b>Exposure Duration (years)</b>	<b>Body weight (kg)</b>
California quail	0.010	0.004	0.004	0.1	360	2	0.15
Red-tailed hawk	0	0.1	0.001	0.1	360	2	1.0
Western harvest mouse	0.0066	0	0.00012	0.1	360	0.5	0.03
Coyote	0	1.4	0.009	0.1	360	5	20.0

Note: See text for explanation of values.

<sup>1</sup> life history characteristics used to estimate allocation of dose to various food sources

<sup>2</sup> soil ingestion estimated from Beyer and others (1992)

<sup>3</sup> derived from Pascoe and others (1994b; 1996)

TABLE 11-9

**CUMULATIVE DAILY DOSE ESTIMATES FOR SELECTED COECS  
AND RECEPTORS AT THE BURN AREA**

Chemical	Estimated Dose (mg/kg-day)			
	California quail	Red-tailed hawk	Western harvest mouse	Coyote
Cadmium	0.075	2.5	1.4	1.8
Copper	6.2	3.9	1	1.3
Lead	17.3	5.3	2.6	3.3
Mercury	0.004	0.007	0.004	0.005
Zinc	17.4	25.6	13.7	17.3

Note: Calculated using maximum concentrations from Table 11-2 and equation in Section 11.3.3.  
mg/kg-day = milligrams per kilogram per day

TABLE 11-10

**SUMMARY MATRICES FOR MOST SIGNIFICANT CORRELATIONS AMONGST  
SELECTED VARIABLES IDENTIFIED FOR THE BURN AREA**

Spearman Correlation Table for Selected Constituents of Soils Analysis at Concord Inland, Burn Area<sup>†</sup>

	Cation Exchange Capacity	Potassium	Sulfate-S	Solid Phase Microtox	Percent Solids	Percent Moisture
Cation Exchange Capacity		-0.5185 ( 10) 0.1246	-0.5079 ( 10) 0.1340	-0.7716 ( 10) 0.0089	-0.9416 ( 10) 4.748E-005	0.751 ( 10) 0.0071
Potassium	-0.5185 ( 10) 0.1246		0.2555 ( 10) 0.4762	.6442 ( 10) 0.0444	0.4434 ( 10) 0.1993	-0.5821 ( 10) 0.0775
Sulfate-S	-0.579 ( 10) 0.1340	0.2555 ( 10) 0.4762		0.7478 ( 10) 0.0129	0.6181 ( 10) 0.0568	-0.6101 ( 10) 0.0611
Solid Phase Microtox	-0.7716 ( 10) 0.0089	0.6442 ( 10) 0.0444	0.7478 ( 10) 0.0129		0.7951 ( 10) 0.0060	-0.7090 ( 10) 0.0217
Percent Solids	-0.9416 ( 10) 4.74E-005	0.4434 ( 10) 0.1993	0.6181 ( 10) 0.0568	0.7951 ( 10) 0.0060		-0.6513 ( 10) 0.0414
Percent Moisture	0.7851 ( 10) 0.0071	-0.0521 ( 10) 0.0775	-0.6101 ( 10) 0.0611	-0.7090 ( 10) 0.0217	-0.6513 ( 10) 0.0414	

Note: the values in the table are listed as follows:

correlation value  
(sample size)  
probability



TABLE 11-11

**SUMMARY MATRICES FOR MOST SIGNIFICANT CORRELATIONS  
AMONGST SELECTED VARIABLES IDENTIFIED FOR  
THE BURN AREA**

Pearson Correlation Table for Selected Constituents of Soils Analysis at Concord Inland, Burn Area

	Cation Exchange Capacity	Iron	Sulfate-S	Solid Phase Microtox	Percent Solids	Percent Moisture
Cation Exchange Capacity		-0.8044 ( 10) 0.0050	-0.6862 ( 10) 0.0284	-0.6310 ( 10) 0.0504	-0.9501 ( 10) 2.548E-005	0.8391 ( 10) 0.0024
Iron	-0.8044 ( 10) 0.0050		0.8140 ( 10) 0.0042	0.6825 ( 10) 0.0297	0.7704 ( 10) 0.0091	-0.5862 ( 10) 0.0749
Sulfate-S	-0.6862 ( 10) 0.0284	0.8140 ( 10) 0.0042		0.7916 ( 10) 0.0064	0.6891 ( 10) 0.0275	-0.5597 ( 10) 0.0925
Solid Phase Microtox	-0.6310 ( 10) 0.0504	0.6825 ( 10) 0.0297	0.7916 ( 10) 0.0064		0.5015 ( 10) 0.1397	-0.6466 ( 10) 0.0433
Percent Solids	-0.9501 ( 10) 2.548E-005	0.7704 ( 10) 0.0091	0.6891 ( 10) 0.0275	0.5015 ( 10) 0.1397		-0.7403 ( 10) 0.0143
Percent Moisture	0.8391 ( 10) 0.0024	-0.5862 ( 10) 0.0749	-0.5597 ( 10) 0.0925	-0.6466 ( 10) 0.0433	-0.7403 ( 10) 0.0143	

Note: the values in the table are listed as follows:

correlation value

(sample size)

probability

TABLE 11-12

## TOXICITY REFERENCE VALUES (TRVS)

Chemical	TRV (mg/kg-day) <sup>1</sup>							
	California quail		Red-tailed hawk		Western harvest mouse		Coyote	
	High	Low	High	Low	High	Low	High	Low
Cadmium	8.6	0.14	4.57	0.07	2.68	0.06	0.31	0.01
Copper	73.01	3.73	38.79	1.98	591.95	2.67	67.76	0.31
Lead	15.29	0.011	8.12	0.006	205.56	0.003	23.53	0.0003
Mercury	0.34	0.07	0.18	0.04	9.7	0.46	0.1	0.01
Zinc	318.48	31.85	169.22	16.92	740.63	9.1	84.78	1.04

<sup>1</sup> Draft TRVs were developed by the Navy in conjunction with the Region 9 BTAG.

TABLE 11-13

# HAZARD QUOTIENTS (HQs) COMPARING ESTIMATED DOSES TO TRVS FOR TERRESTRIAL RECEPTORS

1989  
15000  
0

Chemical	Hazard Quotients Estimated daily dose/TRV							
	California quail		Red-tailed hawk		Western harvest mouse		Coyote	
	HQ <sub>1</sub>	HQ <sub>2</sub>	HQ <sub>1</sub>	HQ <sub>2</sub>	HQ <sub>1</sub>	HQ <sub>2</sub>	HQ <sub>1</sub>	HQ <sub>2</sub>
Cadmium	0.01	0.54	0.55	35.7	0.52	23.33	5.8	180
Copper	0.08	1.66	0.1	1.97	0.37	16.67	0.02	4.19
Lead	1.13	1572.73	0.65	883.33	0.01	866.67	0.14	11,000
Mercury	0.01	0.06	0.04	0.17	0.0004	0.009	0.05	0.5
Zinc	0.05	0.55	0.15	1.51	0.02	1.51	0.2	16.63

Notes:

HQ<sub>1</sub> = Dose/High TRVHQ<sub>2</sub> = Dose/Low TRVHQ<sub>1</sub> > 1.0 indicates riskHQ<sub>2</sub> < 1.0 indicates no riskHQ<sub>2</sub> > 1.0 indicates need for further evaluation

## 12.0 CONTAMINANT FATE AND TRANSPORT

The fate and transport of contaminants depends on the physical and chemical properties of the chemicals released, the nature of the release, and the physical, chemical, and biological characteristics of the environment into which the contaminants have been released. At NWS Concord Inland Area sites, a few compounds have been released to surface soil, subsurface soil, and groundwater at the five sites. The potential routes of migration of COPCs at these sites has been previously described in Sections 5.7 (Site 13), 6.7 (Site 17), 7.7 (Site 22), 8.7 (Site 24A), and 9.7 (Site 27). The HHRA (Section 10.0) determined which COPCs are chemicals of concern (COCs) for the residential exposure scenario. These COCs are summarized by site in Table 12.1. This section summarizes physical and chemical processes governing fate and transport of COCs, reviews the factors that affect contaminant persistence of COCs in soil and groundwater, and discusses processes that affect site-specific contaminant migration.

As stated in Section 10.4.1.4, TPH concentration values were not used in the HHRA, because no EPA toxicity values exist for TPH. Similarly, no information on physical or chemical properties exists for TPH, because it consists of complex mixtures of petroleum-derived fuels, oils, and greases containing several hundred hydrocarbons each (ORNL 1989). When these materials are released to the environment, they undergo various physical, chemical, and biological fate mechanisms, known collectively as "weathering," which modify their chemical compositions and potential toxicities (MDEQ 1994).

Because of the complex nature of petroleum-derived fuels, oils, and greases, potential human health and ecological risks associated with soils contaminated with these materials are difficult to evaluate. For this RI, the analytical characterization of soils contaminated with petroleum hydrocarbons was completed using EPA Method 8015 (TPH-G, TPH-D, or TPH-motor oil). This non-specific method of analysis measures ranges and general types of hydrocarbons, but does not identify specific hydrocarbons which may be of toxicological significance (for example, BTEX and PAHs). As a result, the DTSC has determined that TPH values are not useful for human health risk evaluation of petroleum-contaminated sites, as stated in the *Preliminary Endangerment Assessment Guidance Manual* (DTSC 1994c). This position is re-iterated in a California Environmental Protection Agency (Cal-EPA) technical memorandum issued October 28, 1994, *Recommended Outline for Using U.S. Environmental Protection Agency Region IX Preliminary Remediation Goals in Screening Risk Assessments at Military Facilities*

(Cal-EPA 1994). According to these guidance documents, where the types or sources of petroleum hydrocarbons are not known, then full analytical scans for VOCs (for example, CLP volatile organic analysis [VOA]) and SVOCs (for example, CLP semivolatile organic analysis [SVOA]) should be performed to identify the presence of critical constituents, as was done for the Inland Area sites. The persistence of TPH at the Inland Area sites is assessed by these “critical” or “principal” constituents. In addition to these principal constituents, TPH is discussed in Section 12.4, Site-Specific Fate and Transport.

The information contained in Sections 12.1 through 12.4 was compiled to achieve the following objectives:

- Describe important physical and chemical processes governing fate and transport of site-related COCs in soil, groundwater, and storm water
- Collect physical and chemical data on site-related COCs to enhance understanding of their mobility and persistence in the environment
- Estimate potential mobility of site-related COCs.

## **12.1 PHYSICAL AND CHEMICAL PROCESSES AFFECTING FATE AND TRANSPORT**

Physical processes that affect fate and transport of aqueous and nonaqueous constituents include volatilization, advection, dispersion, molecular diffusion, and non aqueous phase liquids (NAPL) transport. Principal chemical processes include water solubility, sorption/desorption, hydrolysis, oxidation-reduction reactions, precipitation/dissolution reactions, and biological process. Each process is discussed in the following subsections.

### **12.1.1 Volatilization**

Compounds with high vapor pressures and low solubilities undergo a phase change from a solution or pure phase to a gaseous phase. Volatilization can occur both in the surface and subsurface environment. Temperature, pressure, constituent concentration, the area of the solution/air interface, and the degree of sorption all effect the rates of volatilization. Volatilized contaminants from the surface go directly to the atmosphere; however, subsurface volatilized compounds follow a tortuous path that may result in resorption of contaminants. The volatility of a compound can be described using the Henry's Law

constant (Table 12-2). A compound's volatility is significantly affected by its vapor pressure, molecular weight, temperature, chemical composition of the liquid and Henry's Law constant. Constituents with a Henry's Law constant of less than  $10^{-7}$  atmosphere-cubic meter per mole ( $\text{atm}\cdot\text{m}^3/\text{mol}$ ) are considered nonvolatile; those between  $10^{-7}$  and  $10^{-5}$   $\text{atm}\cdot\text{m}^3/\text{mol}$  will volatilize slowly. Volatilization increases and becomes an important transfer mechanism at Henry's Law constants of greater than  $10^{-5}$   $\text{atm}\cdot\text{m}^3/\text{mol}$  (Montgomery 1991) for molecular weights of less than 200 grams per mole and vapor pressures greater than 0.001 millimeters of mercury. Based on the Henry's Law constants, the fate and transport of chemicals from volatilization is probably important only for anthracene in the soil at Site 24A and TCE in groundwater at Site 22.

### **12.1.2            Advection**

Advection is the process by which dissolved chemicals are transported by the bulk motion of flowing groundwater. As a result of advection, nonreactive, nonsorbing constituents such as chloride are transported at an average rate equal to the average linear velocity (hereafter referred to as velocity) of groundwater flow. In flow systems dominated by advection, the chemical front of a compound migrating from a contaminant source generally remains well defined, and the chemical tends to be transported as a slug. In addition, the concentration of a contaminant at a point downgradient from the source tends to increase rapidly with time when the chemical front approaches.

In contrast, the chemical front tends to spread out in a system in which dispersion or molecular diffusion is as dominant, or more dominant, than advection. In this case, the concentration at a downgradient location increases more gradually when the chemical front arrives. As a result of advection, dissolved nonreactive chemicals - chemicals that do not adsorb to or otherwise interact with the geologic matrix or in response to changes in chemical equilibrium - are transported at the same rate as the groundwater flow velocities. Advective processes at the Inland Area sites are significant only for inorganic constituents in the groundwater, specifically manganese in the groundwater at Site 13.

### **12.1.3            Dispersion and Molecular Diffusion**

Dispersion in porous media refers to the spreading of a given volume of chemical as it flows through the subsurface as a result of spatial variations in hydraulic conductivity. The type of dispersion that occurs as part of contaminant transport in groundwater is generally referred to as hydrodynamic dispersion.

Hydrodynamic dispersion includes mechanical mixing (mechanical dispersion) during fluid advection as well as molecular diffusion. Mechanical dispersion may be important for groundwater transport of chemicals at Sites 13, 17, and 22.

Molecular diffusion is the process whereby chemicals move from points of higher concentration to points of lower concentration under the influence of the compound's kinetic activities. The effect of diffusion on chemical transport is a function of the concentration gradient and the diffusion coefficient. Diffusion is a relatively slow process, and may be significant only on a localized basis at the Inland Area sites.

#### **12.1.4            Nonaqueous-Phase Liquid Transport**

Organic chemicals can migrate through porous media by being completely dissolved in water, by containing components that are only partly dissolved in water, or by being a separate organic phase liquid that is immiscible in water. The following discussion addresses immiscible transport or NAPL transport aspects.

One of the most important concerns about NAPL transport is that it is controlled largely by density and viscosity. Organic liquid that is less dense than water (for example, petroleum hydrocarbon distillates, such as gasoline) have a specific gravity of approximately 0.7 and, therefore, float on water. This type of organic liquid is called light NAPL (LNAPL). The spread of LNAPL is largely related to the hydraulic conductivity of the porous medium and localized hydraulic gradient. Most halogenated hydrocarbons (for example, TCE) have specific gravities much greater than 1 and sink in water; these are called dense NAPLs (DNAPL). The spread of DNAPL is largely uncoupled from the hydraulic gradient that drives the advective transport of the dissolved contaminants. Movement of DNAPL may have a significant downward component, but the ability of DNAPL to migrate is influenced substantially by its viscosity and surface-wetting capabilities in water (Schwille 1988).

In addition, organic liquids, such as halogenated aliphatics, are spread by capillary action in an aquifer and leave free-phase liquid behind at 0.3 to 5 percent in pore space volume (Schwille 1988). The NAPL residuals do not continue to migrate, but remain in place in the form of droplets. Over time and with water contact, the residual droplets provide a long-term source of contamination (Powers and others 1991). LNAPL transport is possible at sites with USTs (Sites 13, 17, and 22), since the USTs contain

petroleum hydrocarbons. However, no petroleum hydrocarbon free product was seen during groundwater sampling, so NAPL transport is not suspected at the sites.

#### **12.1.5 Water Solubility**

The solubility of chemicals in water is a function of temperature and specific properties of the chemical species. Table 12-2 presents water solubilities for the organic COCs detected in Inland Area site soils. The larger the solubility value, the greater the amount of chemical that will dissolve in water.

#### **12.1.6 Sorption/Desorption**

Sorption is the process of binding or holding the chemical constituents tightly within the porous matrix, so they cannot be easily leached or transported. The sorption process depends on specific properties of both the chemicals and the soil or aquifer materials. The sorption process is reversible and desorption can occur in response to changing chemical conditions such as pH. Clay materials have strong sorptive properties and the substantial clay and silty clay content in Inland Area soils would likely impede COC movement in the subsurface.

Table 12-2 presents data on the organic carbon partition coefficient ( $K_{OC}$ ). The  $K_{OC}$  quantifies the affinity of the chemical to sorb to organic matter. The larger the  $K_{OC}$ , the greater the preference for the chemical to sorb to organic matter. The soil-water partition coefficient ( $K_D$ ) is related to  $K_{OC}$  by the fraction organic carbon ( $f_{OC}$ ) in the soil. Contaminants sorbed to soil particles can be predicted when  $K_{OC}$ ,  $f_{OC}$ , and groundwater concentrations are known. With the exception of bis(2-ethylhexyl)phthalate and TCE, COCs detected at the Inland Area sites exhibit high  $K_{OC}$  values and thus would have a strong affinity for organic matter contained in site surface and subsurface soils. The high  $K_{OC}$  values also indicate that the COCs will tend to partition to the solid phase and not into soil solution (aqueous) or gaseous phases. The smaller  $K_{OC}$  values for bis(2-ethylhexyl)phthalate and TCE represent less of an affinity for these chemicals to sorb to soil and indicate why these two chemicals were detected in the groundwater.



#### **12.1.7 Hydrolysis**

Hydrolysis is the decomposition of an organic compound, or a metal ion complex, through a reaction with water. The process consists of an exchange between the hydroxyl ion (OH) of a water molecule and an ionic group from the chemical compound, resulting in decomposition of the compound.

Acid-base hydrolysis of a chemical compound results in the formation of a weak acid, base, or both. Acid base hydrolysis controls hydrogen and hydroxyl ion concentration and thus affects the pH of the media. Because the solubility and mobility of inorganic compounds in soils are largely controlled by pH, hydrolysis reactions may ultimately influence the leachability of inorganic constituents in Inland Area soils. For organic COCs at the Inland Area sites, hydrolysis is likely insignificant compared to processes such as biodegradation (discussed in Section 12.1.10).

#### **12.1.8 Oxidation/Reduction**

An oxidation/reduction reaction results when a reacting chemical species (oxidizing agent) accepts electrons from other substances and is thereby reduced, while the reactant (reducing agent) donates electrons to other substances and is oxidized. Oxidation/reduction reactions can be inorganic (often involving strong acids or bases) or organic (such as biological mineralization of hydrocarbons). Changes in oxidation state result in changes in sorption, solubility, toxicity, and other chemical characteristics. The only area where oxidation/reduction reactions have the potential to significantly affect fate and transport of COCs would be the alleged acid sump at Site 17. However, no evidence of the sump has been found and it is likely that it never existed.

#### **12.1.9 Precipitation and Dissolution**

Precipitation occurs when the concentration of a chemical compound in solution exceeds the solubility limit. Inorganic compounds usually form a solid precipitate, while organic compounds form a liquid phase separate from the solvent. Dissolution is essentially the reverse of precipitation. Dissolution occurs when a chemical compound undergoes a phase change from a solid to a liquid. Precipitation and dissolution are influenced by temperature, pressure, concentration, ionic species activity, pH, and ionic strength of the solution. Precipitation and dissolution would occur near the acid disposal area alleged at Site 17.

### **12.1.10 Biological Processes**

Biological processes within the surface and subsurface soils modify the concentration and structure of chemicals in the environment. The biological process of concern at the Inland Area sites is biodegradation. Biodegradation is a general process involving microorganisms by which a chemical is destroyed or transformed into other, usually less harmful, forms. Biodegradation of COCs is influenced by microbial populations, oxygen availability, soil moisture content, temperature, pH, and the availability of nutrients. Biodegradation is likely an important process influencing the fate and transport of COCs at Inland Area sites due to the presence of organic constituents in soils.

## **12.2 PERSISTENCE OF ORGANIC CHEMICALS OF CONCERN**

Each of the processes described in Section 12.1 depends on the physical and chemical properties of the respective organic compounds and the physical and chemical properties of the soil and water. Physical and chemical factors were compiled for each of the site-related COCs detected at the Inland Area sites above screening criteria (Table 12-2). The net effect of these factors is a time-dependent redistribution (transport and fate) of the COCs in the water, soil, and air phases.

The octanol water partition coefficient ( $K_{OW}$ ) is useful in predicting the behavior of organic chemicals, particularly the affinity of a chemical for sorption by organic matter and its bioconcentration into biota. The organic carbon partition coefficient ( $K_{OC}$ ), is also useful in predicting sorption by soil or aquifer materials when the percent organic matter is known, or can be estimated. The mobility of COCs in the soil solution can be predicted using the  $K_{OW}$  and  $K_{OC}$  values.

The persistence of chemicals in the environment is important in assessing how rapidly a COC may degrade in the environment. Table 12-3 summarizes organic chemical persistence data for the Inland Area COCs gathered from Howard and others (1990). These criteria are commonly presented in days for the concentration to be degraded by abiotic (for example, hydrolysis) or biotic processes to one-half of the original concentration. This unit, referred to as the half-life, is the time in days required for the compound to degrade to half of its original concentration.

The physiochemical data from Table 12-2 and the persistence data from Table 12-3 were applied to evaluate site-related organic COCs for overall mobility potential. Each chemical was rated as low,

medium, or high for mobility, volatilization potential, and persistence in groundwater and surface water. The rating of chemicals is based on the ranges in the factors presented in Table 12-4 and the results of this evaluation are presented in Table 12-5.

In general, organic COCs at the Inland Area sites have low to medium mobility but are medium to high in persistence in surface water and groundwater (Table 12-5). Of particular importance at the Inland Area sites is the low mobility associated with the log  $K_{OC}$  values greater than 2.7. This low mobility is a principal factor in retarding COC transport. This retardation is evidenced by the higher concentrations of COCs in the surface soils compared to subsurface soil (depth greater than 0.5 feet bgs).

The persistence of TPH is assessed by the principal constituents of TPH. Additionally, the persistence of petroleum hydrocarbon spills associated with USTs have been studied throughout the state, and there is overwhelming evidence biodegradation of petroleum hydrocarbons released to the subsurface (Rice and others 1995). Therefore, the concentrations of TPH detected at the Inland Area sites are expected to decrease with time.

### **12.3 PERSISTENCE OF INORGANIC CHEMICALS OF CONCERN**

The chemical attenuation and resulting persistence of inorganic COCs in the Inland Area soils was evaluated based on two major types of reactions: (1) precipitation/dissolution; and (2) adsorption/desorption and ion exchange.

Understanding the nature of the chemical form or aqueous speciation for each chemical and compound is important in evaluating the potential for either type of attenuation. The chemical's speciation may be as a monomolecular-charged species, or as some complex charged formation. Speciation can significantly affect the mobility of metals primarily because of its effect on a metal's aqueous solubility, the retention strength of the metal on the exchange site, and the sorption potential of inorganic chemicals within the porous medium.

The precipitation of inorganic minerals from solution is largely controlled by the concentration of calcium carbonate or hydroxides, and by the percentage of organic materials or clay. The solubility of calcium carbonate is affected by carbonate equilibria, including the partial pressure of carbon dioxide, the pH of the solution, and the concentration of calcium presented. The concentration of carbon dioxide

in natural and agricultural soil may be 100 times or more higher than the level in the atmosphere (Bolt and Breggenwert 1978). Calcium carbonate solubility is strongly influenced by the pH of the soil solution.

The persistence of inorganic constituents in the Inland Area soils is also influenced by the other factors that affect the precipitate or coprecipitate (a minor component precipitating with another more major component) of metals. Many metal ion species have been shown to incorporate themselves into coatings on grains by coprecipitation effects with calcite and other alkaline earth carbonates. Coprecipitation with other mineral phases, such as ferric oxyhydroxides, has also been postulated (Hem 1989). Aluminum, iron, and manganese are known to form amorphous precipitates of oxides and hydroxides that form the basis for the sorption sites for other metals.

Adsorption/desorption and ion exchange reactions also influence the persistence of inorganic constituents as potential contaminant sources at the Inland Area sites. Adsorption occurs when an ion or molecule becomes attached to the surface of a solid particle such as a clay. Metals are also known to adsorb to oxides and oxyhydroxides of aluminum, iron, and manganese in the subsurface. In systems with hydrous oxides, it is often difficult to differentiate among coprecipitation, sorption, and ion exchange.

The ion exchange capacity for soils is pH dependent and increases with increasing pH. Clays and oxides at neutral pHs have relatively high ion exchange capacities. Soil, in general, carries a net negative charge and therefore, has a greater affinity for cations (positively charged ions) rather than anions (negatively charged ions). Cation exchange capacities (CEC) for common soil constituents range from 3 to 150 milliequivalents per 100 grams (meq/100g) for clay. Soil organic material may have a CEC of 100 to 350 meq/100g (Dragun 1988). Inland Area soils typically have medium to high clay contents and some organic matter.

#### **12.4 SITE-SPECIFIC FATE AND TRANSPORT**

Based on the previous discussion of general fate and transport mechanisms, the following section describes the fate and transport of COCs and TPH at each site during the RI and SWMU investigation.

### Site 13 - Burn Area

The COCs for soil are benzo(a)pyrene and beryllium. Benzo(a)pyrene was detected in two soil samples from the trenches at levels comparable to those typically found in urban and rural soil samples (ATSDR 1996). As seen in Table 12-5, benzo(a)pyrene has low mobility and low persistence if it were to come in contact with storm water. Benzo(a)pyrene is likely to stay on site. Beryllium was detected in soil samples collected from trenches and contingency borings, so its presence appears to result from historical site activities. Beryllium is likely to persist at the site; however, as described in Section 12.3, metals tend to bond with clay, which decreases their mobility. There is a potential for metal movement via airborne transport of particulates. However, the lack of metals detected beyond the burning areas indicates that metals are not likely to be transported off site. Additionally, the site is vegetated, which reduces wind erosion.

TPH-motor oil was detected in 10 surface soils samples from trenches across the site and from the drainage ditch along Wake Way. The TPH-motor oil detected in the trenches is probably from ordnance burning. The TPH-motor oil at low concentrations (less than 25 mg/kg) in the drainage ditch may result from transport from the site, or from runoff from the asphalt road. No other chemicals were detected in drainage ditch samples, so it is more likely that the TPH-motor oil is from the roads rather than the site.

Manganese is the only COC in groundwater and was detected in both upgradient and downgradient wells. Manganese was only detected once in the soil above its PRG. The sample with the manganese concentrations greater than the PRG was collected away from site activities at a location that was originally selected to evaluate ambient values. Manganese is found as a native constituent in soil and groundwater throughout the Inland Area. Due to its location and low frequency of detections at concentrations exceeding PRGs, manganese in soil is not believed to be a result of site activities. Manganese is likely to continue to be transported by groundwater.

TPH-D was detected in samples from two monitoring wells, one of which was hydraulically upgradient from the site. Because TPH-D was not detected in the soil but it was detected in the upgradient well, TPH-D is not believed to be from site activities. TPH-D will migrate in groundwater, but will also biodegrade with time.

## Site 17 - Building IA-24

Benzo(a)pyrene, beryllium, and lead are the COCs in soil. Benzo(a)pyrene was detected in three surface soil samples collected from the drainage ditch at concentrations that correlate with TPH detections in these samples. The highest detection of benzo(a)pyrene is associated with the highest detection of TPH in soil samples. As discussed in Section 12.0, benzo(a)pyrene is a constituent of TPH. As seen in Table 12-5, benzo(a)pyrene has low mobility and low persistence in storm water. However, benzo(a)pyrene may be transported on soil particles mobilized by storm water runoff in drainage ditches. Lead was detected in two soil samples at concentrations greater than its PRG and both of these surface soil samples were from drainage ditches. Lead may also be transported on soil particles mobilized by storm water runoff in the drainage ditches. Beryllium was detected in soil samples across the site at concentrations greater than its PRG of 0.14 mg/kg. However, beryllium's ambient value of 0.56 mg/kg was only exceeded once by a concentration of 0.58 mg/kg, detected in drainage ditch sample ACSSB038. Therefore, beryllium concentrations are likely associated with the ambient conditions. Beryllium will persist at the site because it is a component of the soil.

Arsenic and beryllium are the COCs in sediment. Both of these metals were detected at concentrations that exceeded their PRGs and were lower than their ambient values. Therefore, the concentrations of arsenic and beryllium in sediment appear to be associated with ambient conditions. These metals will persist at the site because they are components of the sediment.

TPH-motor oil was detected from six surface soils samples in the drainage ditch and from five sediment samples in Seal Creek. The TPH-motor oil detected in the drainage ditch may result from transport from the site, from the asphalt areas throughout the site, or from the railroad tracks adjacent to the drainage ditch. The TPH-motor oil in Seal Creek is a result of discharge from the drainage pipe of the former steam cleaner. The TPH-motor oil may be transported from storm water runoff in the drainage ditches and Seal Creek. TPH-motor oil will eventually biodegrade, but because it is a long-chain hydrocarbon, it will persist longer than a short-chain hydrocarbon such as gasoline.

Bis(2-ethylhexyl)phthalate is the only COC in groundwater. Bis(2-ethylhexyl)phthalate is a common laboratory contaminant and was detected in the laboratory blank at 5 µg/L. Based on the 10-times rule, if the concentration of bis(2-ethylhexyl)phthalate in a groundwater sample was 50 µg/L or less, then it would be qualified as nondetected (Appendix I). However, bis(2-ethylhexyl)phthalate was detected at

concentrations of 60 and 55 µg/L during the first round of groundwater sampling and it was not detected during the second round of sampling. Because these concentrations are over 50 µg/L, bis(2-ethylhexyl)phthalate is considered to be present in the groundwater samples even though some bis(2-ethylhexyl)phthalate was introduced in the laboratory. Some of the bis(2-ethylhexyl)phthalate detected during the first round of sampling may have come from the new wells. Bis(2-ethylhexyl)phthalate is a standard polyvinyl chloride (PVC) plasticizer and may have resulted from the newly installed PVC wells constructed prior to the first round of sampling. As seen in Table 12-5, bis(2-ethylhexyl)phthalate has low mobility and high persistence in groundwater. However, since it was detected only in the first round of sampling, it is likely that a source of bis(2-ethylhexyl)phthalate does not exist at the site.

#### **Site 22 - Building 7SH5**

Arsenic and lead are the COCs in soil. Arsenic was detected in soil samples from across the site at concentrations exceeding its PRG, while only the samples from the drainage ditch and trench had concentrations greater than its ambient value of 15 mg/kg. Arsenic in the drainage ditch samples may be the result of the high clay content of ditch soil and the deposition of fines during slow storm water flow through the ditches. As described in Section 12.3, clays have a relatively high ion exchange capacity and they are negatively charged, resulting in an affinity for positively charged metal ions. Fine-grained soil has a greater surface area than coarse-grained soil so there is more area for adsorption of metals. Lead was detected in one sample from the drainage ditch at a concentration greater than its PRG. Both arsenic and lead are likely to persist and may be transported on soil particles mobilized during fast storm water flow in the drainage ditches.

TPH-D and TPH-motor oil were detected in soil samples collected near the UST pipeline, and TPH-motor oil was detected in surface soil samples from the drainage ditch. Both the TPH-D and TPH-motor oil appear to result from leaks associated with the UST pipeline. The TPH-motor oil may be transported off site from storm water runoff into the drainage ditches. TPH-D and TPH-motor oil will eventually biodegrade, but because they are long-chain hydrocarbons they will persist longer than a short-chain hydrocarbon such as gasoline.

TCE is the only COC in groundwater. TCE is a commonly used chlorinated solvent and its presence in groundwater could be from historical site activities, or it could be from an off-site source. As seen in

Table 12-5, TCE has high mobility and high persistence in groundwater. TCE is likely to continue to be transported by groundwater.

TPH-motor oil was detected in all three grab groundwater samples. The TPH-motor oil in the groundwater probably results from UST pipeline leaks and spills during use of the UST. The TPH-motor oil will migrate in groundwater, but will also biodegrade with time.

#### **Site 24A - Pistol Firing Range**

The COCs in soil are PAHs (anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene), arsenic, beryllium, and lead. The PAHs were detected in two soil samples collected from one soil boring and analyzed for SVOCs because of an organic odor noticed during sampling. The PAHs likely result from the coal tar creosote used as a wood preservative on timbers used on site for retaining walls. Creosote has a characteristic sharp odor (Merck 1983). As seen in Table 12-5, the PAHs have low mobilities and range from low to high persistence in storm water. If PAH are present in surface soil then they may be transported on soil particles mobilized by storm water runoff in drainage ditches. Arsenic and beryllium are indigenous to site soil. Lead is a result of the bullets present in the site's target berm.

The metals are likely to persist at the site; however, as described in Section 12.3, metals tend to bond with clay, which decreases their mobility. Although these metals may be bound to the soil, they are also being transported off site in storm water draining from the site.

#### **Site 27 - Building IA-20**

The COCs in soil are PCBs (Aroclor-1248 and Aroclor-1254) and pesticides (alpha-chlordane, gamma-chlordane, dieldrin, and 4,4'-DDD). According to Table 12-5, these PCBs and pesticides have low mobility and high persistence. These traits are substantiated by the fact that these PCBs and pesticides were found in the surface soil at the site but not in any of the samples collected at 3 feet bgs. The pesticides are probably from application around the buildings for termite control. The source of the PCBs is not evident. The surface soil containing these COCs may be transported off site in storm water draining the site.



TPH-D and TPH-motor oil were detected in soil samples collected in the drainage swale. TPH-motor oil was detected in surface soil samples from the drainage ditch and around the buildings. Both the TPH-D and TPH-motor oil appear to result from leaks associated with the UST, spills from the use of the UST, or applications of TPH for weed and dust control. The TPH-motor oil may be transported off site from storm water runoff into the drainage channel. TPH-D and TPH-motor oil will eventually biodegrade, but because they are long-chain hydrocarbons they will persist longer than a short-chain hydrocarbon such as gasoline.

**TABLE 12-1**  
**CHEMICALS OF CONCERN**  
**NWS CONCORD, INLAND AREA SITES, CALIFORNIA**  
**(CONTINUED)**

Site	Organic Chemicals	Inorganic Chemicals
Subsurface Soil	Alpha-Chlordane Gamma-Chlordane Aroclor-1248 Aroclor-1254 Dieldrin	

**Note:**

These chemicals of concern are based on residential scenarios as determined in Section 10.0.

Surface soil includes soil samples collected from 0.0 to 0.5 feet bgs.

Subsurface soil includes soil samples collected from 0.0 to 10.0 feet bgs.

PAH - Polynuclear Aromatic Hydrocarbons

\* The other PAHs detected above PRGs include anthracene, benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene.

TABLE 12-2

**PHYSICAL-CHEMICAL PROPERTIES OF POTENTIAL SITE-RELATED ORGANIC CHEMICALS OF CONCERN  
NWS CONCORD, INLAND AREA SITES, CALIFORNIA**

CAS# Number	Analyte	COC <sup>a</sup> Medium	Analyte Class <sup>c</sup>	Chlorinated (Y/N) <sup>d</sup>	Solubility (mg/L at 25°C)	Vapor Pressure (mm Hg at 20°C)	Henry's Law Constant (atm-m <sup>3</sup> /mol at 20°C)	Log K <sub>ow</sub> <sup>e</sup>	K <sub>oc</sub>	Log K <sub>oc</sub>	Molecular Weight	Density (g/cm <sup>3</sup> at 20°C)
120-12-7	Anthracene <sup>1</sup>	soil	S	N	7.50E-02	1.95E-04	6.51E-05 (25°C)	4.54	2.57E+04	4.41	178	1.28
12672-29-6	Aroclor 1248 <sup>6</sup>	soil	B	Y	5.4E-02	4.94E-04 (25°C)	2.80E-03 (25°C)	6.20	--	--	300	1.44 (25°C)
11097-69-1	Aroclor 1254 <sup>10,12,13,15B,15T,15T1</sup>	soil	B	Y	1.2E-02 to 7.0E-02 (20°C)	6.0E-05	2.8E-04	5.6-8	2.0E+05 to 5.0E+07	5.30 to 7.70	328	1.47-1.49 (90°C)
56-55-3	Benzo(a)anthracene <sup>1</sup>	soil	S	N	1.40E-02	1.10E-07	8.00E-06	5.91	1.38E+06	6.14	228	1.27
50-32-8	Benzo(a)pyrene <sup>1,7</sup>	soil	S	N	4.00E-03	5.60E-09	4.90E-07 (25°C)	6.50	1.95E+06	6.29	252	1.35
205-99-2	Benzo(b)fluoranthene <sup>1</sup>	soil	S	N	1.20E-03	5.00E-07	5.03E-07	6.57	5.50E+05	5.74	252	--
207-08-9	Benzo(k)fluoranthene <sup>23,4,5</sup>	soil	S	N	7.60E-04	9.59E-11 (25°C)	4.24E-07	6.84	--	--	252	--
57-74-9	Chlordane <sup>11,38,60,12,10,15B</sup>	soil	P	Y	5.6E-02	1.00E-05	2.2E-04 (25°C)	5.48	3.8E+04	4.58	409	1.6000 (25°C)
5103-71-9	alpha-chlordane	soil	P	Y	--	--	8.6E-04 (25°C)	--	--	--	--	--
5564-34-7	gamma-chlordane	soil	P	Y	--	--	1.3E-03 (25°C)	--	--	--	--	--
218-01-9	Chrysene <sup>1,7</sup>	soil	S	N	6.00E-03	6.30E-09	1.05E-06 (25°C)	5.91	2.45E+05	5.39	228	1.27
53-70-3	Dibenz(a,h)anthracene <sup>1,7</sup>	soil	S	N	2.49E-03	1.00E-10	7.30E-08 (25°C)	6.50	1.66E+06	6.22	278	1.28
60-57-1	Dieldrin <sup>1</sup>	soil	P	Y	1.95E-01	2.80E-08	2.90E-05	5.16	1.41E+04	4.15	381	1.75
72-54-8	DDD <sup>10,62,11,7</sup>	soil	P	Y	1.6E-01 (24°C)	1.3E-09 to 2.5E-09 (25°C)	3.1E-05 (25°C)	5.56	2.4E+05	5.38	320	--
193-39-5	Indeno(1,2,3-cd)pyrene <sup>1</sup>	soil	S	N	6.20E-02	1.00E-10	286E-07	7.70	3.09E+07	7.49	276	--
117-81-7	Bis(2-ethylhexyl)phthalate <sup>11,29,31, 63,68,1219</sup>	groundwater	S	N	4.0E-01	2.0E-07	2.5E-07	3.98, 5.11	6.2E+04	4.79	390	0.9861
79-01-6	Trichloroethene <sup>7,10,29,38,62</sup>	groundwater	S	Y	1.0E+03 (20°C)	5.87E+01	9.10E-03	2.42	1.27E+02	2.10	131	1.4620

TABLE 12-2

**PHYSICAL-CHEMICAL PROPERTIES OF POTENTIAL SITE-RELATED ORGANIC CHEMICALS OF CONCERN  
NWS CONCORD, INLAND AREA SITES, CALIFORNIA  
(CONTINUED)**

a	Chemical Abstracts Service
b	Chemical of concern
c	Analytes are classified as semivolatile organic compounds (S), pesticides (P), or polychlorinated biphenyls (B).
d	For organic compounds, N indicates that the compound is not chlorinated; Y indicates that the compound is chlorinated.
e	Octanol/water partition coefficient
f	Organic carbon partition coefficient
-- Information not available	
	mg/L - Milligrams per liter
	mm Hg - Millimeters of mercury
	atm-m <sup>3</sup> /mol - Atmospheres-cubic meters per mole
	g/cm <sup>3</sup> - grams per cubic centimeter
	K <sub>ow</sub> - Octanol/water partition coefficient
	K <sub>oc</sub> - Organic carbon partition coefficient
<b>References:</b>	
1	Information gathered from Montgomery, JH (1996); Montgomery and Welkom (1989); Merck Index, Eleventh Edition; National Institute of Occupational Safety and Health (1994); Howard and others, 1990; EPA (1987); EPA (1988).
2	USEPA, 1987
3	Leo, A.C. et al., 1971
4	Weast, 1988-1989
5	USEPA, 1980
6	U.S. Department of Health and Human Services, 1996.
7	USEPA 1982
10	Callahan, M.A., M.W. Slimak, N.W. Gabel, J.P. May, J.R. Fowler, P. Jennings, R.L. Durfee, F.C. Whitmore, B. Maestri, W.R. Mabey, B.R. Holt, and C. Gould, 1979
12	Clayton, G.D. and F.E. Clayton, eds., 1981
21	Hawley, G.G., ed., 1981
29	Leo, A., 1983
31	Mabey, W.R., J.H. Smith, R.D. Podoli, J.L. Johnson, T. Mill, T.W. Chou, J. Gates, and I. Waight-Partridge, 1981
38	Mackison, F.W., R.S. Stricoff, and L.J. Partridge, Jr., 1981
48	Reid, R.C., J.M. Prausnitz, and T.K. Sherwood, 1977
60	U.S. Coast Guard, 1978
61	Verschuere, K., 1983
62	Values were estimated by Arthur D. Little using K <sub>ow</sub> as the basis of estimation.
63	Geyer, H., P. Sheehan, D. Kotzias, D. Freitag, and F. Korte, 1982
68	Wolfe, N.L., W.C. Steen, and L.A. Burns, 1980
1210	Laskowski, D.A., C.A.I. Goring, P.J. McCall, and R.L. Svrann, 1982
1219	Values were estimated by Arthur D. Little, Inc.
131	Rao, R.S.C., A.G. Hornsby, and R.E. Jessup, 1985
1571	Burkhard, L.P., D.E. Armstrong, and A.W. Audren, 1985
1533	Griffin, R.A. and E.S.K. Chian, 1980
2147	Kadeg, R.D., S.P. Pavlou, and A.S. Duxbury, 1986
2269	Value estimated using vapor pressure and solubility data from reference 10.

TABLE 12-3

**PERSISTENCY OF ORGANIC CHEMICALS OF CONCERN  
NWS CONCORD, INLAND AREA SITES, CALIFORNIA**

CAS Number <sup>a</sup>	Analyte	Half-life (days)		
		Soil	Surface Water	Groundwater
120-12-7	Anthracene <sup>b</sup>	50-460	0.02-0.07	100-920
12672-29-6	Aroclor 1248 <sup>c</sup>	--	17-210 <sup>c,d</sup>	--
11097-69-1	Aroclor 1254 <sup>c</sup>	--	17-210 <sup>c,d</sup>	--
56-55-3	Benzo(a)anthracene <sup>b</sup>	102-680	0.04-0.13	204-1,360
50-32-8	Benzo(a)pyrene <sup>b</sup>	57-530	0.02-0.05	114-1,060
205-99-2	Benzo(b)fluoranthene <sup>b</sup>	360-610	0.36-30	720-1,220
207-08-9	Benzo(k)fluoranthene <sup>e</sup>	908.9-2,138.9	0.16-20.8	1821.3-4270.5
117-81-7	Bis(2-ethylhexyl)phthalate <sup>e</sup>	5-23	5-23	10-389
57-74-9	Chlordane <sup>e,f,g</sup>	1204.5 <sup>f</sup>	3.6-26 <sup>g</sup>	--
5103-71-9	-alpha <sup>b</sup>	--	--	--
5564-34-7	-gamma <sup>b</sup>	--	--	--
218-01-9	Chrysene <sup>b</sup>	371-1,000	0.18-0.54	722-2,000
75-54-8	DDD <sup>h</sup>	--	--	--
53-70-3	Dibenz(a,h)anthracene <sup>b</sup>	361-940	0.25-32.6	722-1,880
60-57-1	Dieldrin <sup>i,j</sup>	175-1,096	327	--
193-39-5	Indeno(1,2,3-cd)pyrene <sup>b</sup>	600-730	125-250	1,200-1,460
79-01-6	Trichloroethene <sup>e</sup>	186-365	186-365	331.7-1642.5

-- Information not available

<sup>a</sup> Chemical Abstracts Service

<sup>b</sup> Howard and others (1990)

<sup>c</sup> U.S. Department of Health and Human Services (1996)

<sup>d</sup> Data estimated from general PCBs

<sup>e</sup> Howard and others (1991)

<sup>f</sup> Rao PSC, Davidson, J.M. (1982)

<sup>g</sup> EXAMS (1985)

<sup>h</sup> Dichlorodiphenyl-dichloroethane

<sup>i</sup> Montgomery (1996)

<sup>j</sup> Lyman and others (1990)

TABLE 12-4

**MOBILITY AND PERSISTENCE FACTOR CLASSES  
NWS CONCORD, INLAND AREA SITES, CALIFORNIA**

Mobility and Persistence Class	Mobility Factors					Persistence Factors	
	Water Solubility (mg/L)	Log $K_{ow}$	Log $K_{oc}$	Vapor Pressure (mm Hg)	Henry's Law Constant (atm- m <sup>3</sup> /mol)	Surface Water Half-Life (days)	Groundwater Half-Life (days)
Low	<10	>3	>2.7	<1.0E-7	<3.0E-7	<0.5	<30
Medium	10 to 1,000	2.7 to 3.0	1.7 to 2.7	1.0E-7 to 0.01	3.0E-7 to 0.001	0.5 - 1.0	30 to 90
High	>1,000	<2.7	<1.7	>0.01	>0.001	>1.0	>90

mg/L - Milligrams per liter

mm Hg - Millimeters of mercury

atm-m<sup>3</sup>/mol - Atmospheres-cubic meters per mol $K_{ow}$  - Octanol/water partition coefficient $K_{oc}$  - Organic carbon partition coefficient

TABLE 12-5

**MOBILITY AND PERSISTENCE FACTOR CLASSES FOR CHEMICALS OF CONCERN  
NWS CONCORD, INLAND AREA SITES, CALIFORNIA**

Analyte	Mobility Factor Classes				Persistence Factors Classes		
	Water Solubility Class	Log $K_{ow}$ Class	Log $K_{oc}$ Class	Vapor Pressure Class	Henry's Law Constant Class	Surface Water Half-Life Class	Groundwater Half-Life Class
Anthracene	low	low	low	medium	medium	low	high
Aroclor 1248	low	low	--	medium	high	high	--
Aroclor 1254	low	low	low	medium	medium	high	--
Benzo(a)anthracene	low	low	low	medium	medium	low	high
Benzo(a)pyrene	low	low	low	low	medium	low	high
Benzo(b)fluoranthene	low	low	low	medium	medium	low to high	high
Benzo(k)fluoranthene	low	low	--	low	medium	low to high	high
Bis(2-ethylhexyl)phthalate	low	low	low	medium	low	high	low to high
Chlordane (alpha & gamma)	low	low	low	medium	medium	high	--
Chrysene	low	low	low	low	medium	low to medium	high
DDD	low	low	low	low	medium	--	--
Dieldrin	low	low	low	low	medium	high	--
Dibenz(a,h)anthracene	low	low	low	low	medium	low to high	high
Indeno(1,2,3-cd)pyrene	low	low	low	low	low	high	high
Trichloroethene	medium to high	high	medium	high	high	high	high

$K_{ow}$  - Octanol/water partition coefficient  
 $K_{oc}$  - Organic carbon partition coefficient  
 -- Information not available

## **13.0 SUMMARY AND RECOMMENDATIONS**

An RI was conducted at five Inland Area sites at NWS Concord, California. The following sites were included in this study: Site 13 - Burn Area, Site 17 - Building IA-24, Site 22 - Building 7SH5, Site 24A - Pistol Firing Range, and Site 27 - Building IA-20. The main purposes of the RI were to (1) characterize the vertical and lateral extent of soil and groundwater contamination at the specified Inland Area sites; (2) conduct baseline human health and ERAs; and (3) assess the potential migration pathways to be used in the FS process to evaluate remedial technologies and alternatives at each site that is found to present a risk to human health or the environment.

The following sections provide site-specific summaries and recommendations based on the RI and SWMU investigation data, presented in Sections 1.0 through 12.0.

### **13.1 SITE 13 - BURN AREA**

The following sections summarize the significant information of the Site 13 chemical characterization, HHRA, ERA, and contaminant fate and transport and present recommendations.

#### **13.1.1 Site 13 - Chemical Characterization**

This section summarizes the chemical characterization at Site 13, including the investigation procedures and results.

Soil and groundwater samples were collected at Site 13 to assess whether ordnance burning has contaminated environmental media at the site. Sampling focused on gullies where burning is known to have taken place, in site drainage channels, and at unbiased grid locations. Soil sampling was conducted by trenching, surface grab sampling, Geoprobe borings, and hollow stem auger drilling. Three monitoring wells were installed at the site during the RI. Two rounds of groundwater sampling were conducted.

The SVOC benzo(a)pyrene was detected in two trench excavation samples at levels exceeding the residential PRG. No other SVOCs or VOCs were detected in soils collected at the site at concentrations exceeding the residential PRGs. Petroleum hydrocarbons detected at the Burn Area are strongly



correlated with the former burning operations conducted in the Site 13 trench excavations. TPH-motor oil at low concentrations was detected in three drainage channel surface soil samples.

The metals aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, lead, manganese, and nickel were detected in soils collected at the Burn Area at concentrations exceeding the residential PRGs. Arsenic concentrations exceeding PRG values were detected at concentrations of less than the estimated ambient limit concentration and arsenic is not considered to be present as a result of site activities. Infrequent detections of metals at concentrations exceeding ambient values in drainage ditch, downslope grid, and downslope monitoring well locations indicate that the metals detected at the trench excavations and upslope areas are not being transported off site. Although barium was detected (18,300 mg/kg) during the SI at a concentration exceeding its TTLC, barium was not detected at elevated concentrations during the RI and the calculated RME did not exceed the industrial PRGs. Barium was thus not identified as a chemical of concern for the industrial scenario RME case.

No organic compounds were detected in the samples collected in the first round of groundwater sampling. TPH-D and 4-methylphenol were detected in the second-round groundwater samples collected from at least one well. No other organic compounds were detected in groundwater samples collected at the site. Manganese was the only metal detected in groundwater samples at concentrations exceeding residential tap water PRGs.

#### **13.1.2 Site 13 - HHRA**

The objective of the HHRA conducted at Site 13 (the Burn Area) was to evaluate the potential carcinogenic risks and noncarcinogenic hazards associated with exposure to COPCs in surface soil (0 to 0.5 feet bgs), subsurface soil (0 to 10 feet bgs), and groundwater at the site and to identify COCs. A COC is a risk driver or chemical with a carcinogenic risk greater than  $1 \times 10^{-6}$  or a hazard quotient greater than 1.

NWS Concord is an open naval base and is not scheduled to close. Typically, there are no personnel at Site 13. Occasional visits are made by individuals who lease the property for cattle grazing and by the natural resources manager for the site. For purposes of this HHRA, activities of these visitors were assumed to be similar to an industrial worker. The risk estimates of an industrial worker are expected to provide an upper bound estimate of the risks to a visitor. Although very unlikely, it was also

conservatively assumed that land use may be unrestricted in the future and that residences are constructed at the site. For these reasons, the following receptors were evaluated in the HHRA: an industrial worker and a resident.

The carcinogenic risks and noncarcinogenic hazards were estimated for these receptors by comparing site concentrations of each COPC to EPA Region IX industrial and residential PRGs (EPA 1996a). For the industrial worker, the RME carcinogenic risks associated with COPCs in surface soil and subsurface soil are below and within the target risk range of  $10^{-6}$  and  $10^{-4}$ . For a resident, the RME carcinogenic risks for surface soil and subsurface soil are within the target risk range and can be attributed to ambient levels of beryllium. Benzo(a)pyrene was also identified as a COC for subsurface soil. Benzo(a)pyrene was only detected in 2 of 125 samples at concentrations (0.07 mg/kg and 0.3 mg/kg) that are comparable to background levels in urban and rural soils. The hazard indices for residential exposure to COPCs in surface soil and subsurface soil are less than the threshold value of 1.

No carcinogenic COPCs were identified in groundwater samples collected at Site 13. Consequently, the total RME carcinogenic risk attributable to all media evaluated at the site is equal to the risks associated with surface soil or subsurface soil alone. The total hazard index associated with residential exposure to COPCs in groundwater exceeds the threshold value of 1 and is attributed to the maximum concentration of manganese. All other manganese concentrations detected in groundwater were below the tap water PRG.

The RME lead concentrations in surface soil and subsurface soil are below the Cal-modified residential PRG and the EPA Region IX industrial PRG. However, analytical results from the RI for Site 13 showed lead present in two trench locations at concentrations (5,590 mg/kg and 3,090 mg/kg) above the industrial PRG and the TTLC. As a result of these elevated lead hits, confirmation samples were collected in February, 1996, in an effort to assess the extent of the previously detected lead. The confirmation samples showed lead at concentrations much lower than those reported previously. Lead concentrations in groundwater were below the residential tap water PRG for lead.

### **13.1.3 Site 13 - ERA**

Several inorganic chemicals were detected above ambient levels in soils from the Burn Area. Those that were detected at levels above ambient and in greater than 10 percent of the soil samples included

antimony, barium, beryllium, cadmium, lead, and zinc. Other than comparison to ambient concentrations, no screening guidelines for soil concentrations are available. Indirect measures of evaluating soil contamination included (1) comparison of WET-DI extractions to chronic AWQC; (2) evaluation of toxicity using Microtox; and (3) evaluation of soil productivity based on pH and nutrient conditions. Results of these evaluations are summarized below.

No chemical detected in WET extractions from soil samples exceeded the chronic freshwater AWQC. WET metal concentrations were generally two to three orders of magnitude less than metal concentrations in bulk soils, indicating that total metals measured in bulk soil are not bioavailable. Additionally, weak acid metal extractions completed as part of the comprehensive soil analysis indicated limited availability of both nutritive and potentially toxic metals, especially in surface soils where incidental ingestion of soil by terrestrial animals is most likely. Microtox bioassays indicated limited adverse effects at the site. Grassland habitat at the Burn Area is predominantly non-native and highly disturbed, confounding interpretations of contaminant-related stress. Based on soil measures of tilth and productivity, the site contains marginal grassland habitat that appears undifferentiated from the surrounding acreage.

A secondary assessment of risk posed by chemicals in soils at Site 13 focused on trophic transfer of contaminants from soil to plant and animal receptors. Results of the food-chain evaluation using conservative exposure parameters indicated potential risk to terrestrial mammals and birds from cadmium and lead, based on HQs. Mercury and zinc evaluations resulted in HQs between 1.0 and 5.0, which were not considered to present a significant risk. These HQs were calculated using maximum concentrations of chemicals in soil samples; actual exposures in the field is expected to be significantly less.

Based on these quantitative and qualitative screening evaluations, observations of the site during field surveys, and the land-use options being considered for the site (that is, no change in management practice), no additional remedial action beyond that proposed based on HHRA is recommended for the Burn Area.

#### 13.1.4 Site 13 - Contaminant Fate and Transport

The following section summarizes the fate and transport of COCs and TPH detected at Site 13 during the RI.

The COCs for soil are benzo(a)pyrene and beryllium. Benzo(a)pyrene was detected in two soil samples from the trenches at levels comparable to typical ambient levels found in urban and rural soil samples (ATSDR 1995). Benzo(a)pyrene has low mobility and low persistence if it were to come in contact with storm water. Benzo(a)pyrene is likely to stay on site. Beryllium was detected in soil samples collected from trenches and borings. Beryllium is likely to persist at the site, because it tends to bond with clay, which decreases its mobility. There is a potential for metal movement via airborne transport of soil particles containing metals. However, the site is vegetated which reduces wind erosion. The lack of metals detected beyond the burning areas suggests that offsite transport has not been significant, which is consistent with the anticipated fate and transport of metals for the area.

TPH-motor oil was detected in 10 surface soils samples from the former burning trenches across the site and from the drainage ditch along Wake Way. The TPH-motor oil detected in the former burning trenches is probably from ordnance burning. The TPH-motor oil at low concentrations (less than 25 mg/kg) in the drainage ditch is probably due to storm water runoff from the asphalt road. No other chemicals were detected in drainage ditch samples.

Manganese, the only COC identified in groundwater, was detected in both upgradient and downgradient wells. Manganese is likely to continue to be detected in groundwater at the site and is assumed also to be transported by groundwater. Manganese is not believed to have resulted from site activities because it was detected only once in soil above its PRG. The soil sample with the elevated manganese was collected from a location away from site activities intended to determine estimated ambient levels. Additionally, manganese occurs naturally in soil throughout the Inland Area.

TPH-D was detected in samples from two monitoring wells, one of which was hydraulically upgradient from the site. Because TPH-D was not detected in soil but was detected in the upgradient well, TPH-D is not believed to be present on site due to site activities. TPH-D will migrate in groundwater, but it will also biodegrade with time.

### **13.1.5 Site 13 - Recommendations**

This section presents recommendations for future activities at Site 13. These recommendations are based on a detailed assessment of site physical and chemical data, results from the HHRA and ERA, and evaluation of contaminant fate and transport.

The HHRA and fate and transport analysis of TPH were evaluated by using principal constituents of TPH known to be toxic. The only principal constituent of TPH determined to be a COC at Site 13 was benzo(a)pyrene in soil. Benzo(a)pyrene was detected at typical levels for urban areas and is expected to stay on site. TPH was also detected in two groundwater samples collected at Site 13. However, TPH in soil and groundwater is expected to biodegrade with time.

The organic COCs are limited to the surface soils on site and are not affecting groundwater. Napalm is present within one of the site's gullies. This napalm and associated contaminated soil is scheduled for removal cleanup in October 1997. With the exception of this cleanup and confirmation sampling, no further action is recommended for soil at Site 13.

Manganese is the only COC for groundwater but its presence in groundwater is believed to be due to the ambient conditions of the site soil. No further action is recommended for groundwater at Site 13.

Grassland habitat at the Burn Area is predominantly non-native and highly disturbed by human activity and cattle grazing, confounding and likely overshadowing contaminant-related stress. The site contains marginal grassland habitat that appears undifferentiated from the surrounding acreage. Based on its relatively small area, common and mobile receptors, and poor quality habitat, no remedial action is warranted.

## **13.2 SITE 17 - BUILDING IA-24**

The following sections summarize the significant information of the Site 17 chemical characterization, HHRA, ERA, and contaminant fate and transport and present recommendations.

### **13.2.1 Site 17 - Chemical Characterization**

This section summarizes the chemical characterization at Site 17, including the investigation procedures and results.

Soil, sediment, and groundwater were sampled at Site 17 to evaluate the nature and extent of chemicals present as a result of past forklift maintenance and use of USTs. Sampling focused on the areas of a suspected battery acid disposal sump, a steam cleaning pad with a discharge line outfall into Seal Creek, a fuel UST at Building IA-55, and the site drainage channels. The site septic system was investigated as part of the SWMU investigation. Soil was sampled by surface grab sampling, Geoprobe borings, and hollow stem auger drilling. Sediment was sampled in Seal Creek by surface grab sampling and Geoprobe borings. Five monitoring wells were installed at the site during the RI. Two rounds of groundwater sampling were conducted.

Benzo(a)pyrene was detected in two drainage channel soil samples at concentrations exceeding the PRG value. No other SVOCs were detected in soil or sediment samples at concentrations exceeding PRG values. No petroleum hydrocarbons were detected in samples collected near the fuel USTs. TPH-motor oil was detected at elevated levels in soil samples collected from the drainage ditch and in sediments collected in Seal Creek. With the exception of TPH, no chemicals were consistently identified above ambient levels in soil samples collected in the vicinity of the drainage ditches. Therefore, storm water sampling is not recommended.

Arsenic and beryllium were detected in the majority of soil samples collected during the RI at concentrations exceeding their residential PRGs; however, arsenic was generally detected in soil at concentrations less than established ambient concentrations and is therefore probably indigenous to the site. Lead and cadmium were detected in drainage channel surface samples at concentrations exceeding PRGs and are likely the result of site activities. Lead was detected in two soil samples from drainage ditches at concentrations greater than its PRG. Lead may also be transported to the drainage ditches with eroded soil particles mobilized by storm water runoff. Beryllium was detected in soil samples across the site at concentrations greater than its PRG of 0.14 mg/kg. However, beryllium's ambient value of 0.56 mg/kg was exceeded only once by a concentration of 0.58 mg/kg, detected in drainage ditch sample ACSSB038. Therefore, the concentrations of beryllium are likely associated with the ambient soil condition.

No physical or chemical evidence was found during the RI to indicate the existence of a former acid sump at the site.

VOCs, SVOCs, and petroleum hydrocarbons have not been detected consistently in groundwater samples collected at the site.

#### **13.2.2 Site 17 - HHRA**

The objective of the HHRA conducted at Site 17 (Building IA - 24) was to evaluate the potential carcinogenic risks and noncarcinogenic hazards associated with exposure to COPCs in surface soil (0 to 0.5 feet bgs), subsurface soil (0 to 10 feet bgs), sediment, and groundwater at the site and to identify COCs. A COC is a risk driver or chemical with a carcinogenic risk greater than  $1 \times 10^{-6}$  or a hazard quotient greater than 1.

NWS Concord is an open naval base and is not scheduled to close. Consequently, based on current land use, Navy personnel are the most likely future receptor. For purposes of this HHRA, activities of base personnel at Site 17 (forklift maintenance operations and truck parking) were assumed to be similar to an industrial worker. Although very unlikely, it was conservatively assumed that land use may be unrestricted in the future and that residences are constructed at the site. For these reasons, the following receptors were evaluated in the HHRA: an industrial worker and a resident.

The carcinogenic risks and noncarcinogenic hazards were estimated for these receptors by comparing site concentrations of each COPC to EPA Region IX industrial and residential PRGs (EPA 1996). For the industrial worker, the RME carcinogenic risks associated with COPCs in surface soil and subsurface soil are within the target risk range of  $10^{-6}$  and  $10^{-4}$  and the total hazard indices for both soil depth intervals are below the threshold value of 1. No industrial COCs were identified for Site 17.

For a resident, the RME carcinogenic risks for surface soil and subsurface soil are within the target risk range and the hazard indices for both soil depth intervals are below the threshold value of 1. COCs identified for soil are beryllium and benzo(a)pyrene. Site concentrations of beryllium are comparable to background concentrations; no source for beryllium was identified. The risk associated with benzo(a)pyrene was based on the maximum concentration (0.1 mg/kg), which is comparable to background levels in urban and rural soils. In addition, the RME carcinogenic risk associated with

COPCs in sediments at Site 17 is within the target risk range and the hazard index is below the threshold value of 1. For sediments, the COCs are arsenic and beryllium. The only groundwater COC identified is bis (2-ethylhexyl)phthalate.

For a resident, the total RME carcinogenic risks attributable to simultaneous exposures to COPCs in soil and groundwater are within the target risk range and the total hazard indices for the site are less than the threshold value of 1.

The RME lead concentrations in surface soil and subsurface soil are significantly below the industrial PRGs. However, the RME lead concentration in surface soil, which is equal to the maximum lead concentration detected at the site, is slightly above the Cal-modified residential PRG. Only three of 46 samples contained lead at concentrations above this residential PRG and the mean lead concentration in surface soil was well below the residential PRG. The RME lead concentration in sediment is less than the residential PRG for soil. Lead was not detected in groundwater samples collected from monitoring wells at Site 17.

### **13.2.3 Site 17 - ERA**

Risk to aquatic biota at Seal Creek were evaluated by comparing site-specific sediment data to (1) site-specific soil ambient concentrations, and (2) effects ranges published by NOAA (Long and Morgan 1991, Long and others 1995). Beryllium in sediment samples exceeded background concentrations for soils in the area. In the single soil sample collected from the creek bank near the discharge pipe, several metals exceeded background concentrations; however, only nickel also exceeded the ER-M

Sediment extraction data was compared to freshwater chronic AWQC. Zinc exceeded the AWQC in one WET extraction sample. The portion of Seal Creek sampled during the RI is deeply scoured during winter storms; sediment sampled during the RI is not necessarily representative of past or future condition due to sediment dynamics. Evaluation of the chemical results indicated little cause for concern. No ecological risk analysis for Site 17 was conducted. However, because Seal Creek is a functional riparian zone potentially affected by activities on the base, its long term management should be addressed under the Natural Resource Management Plan produced by NWS Concord.



#### **13.2.4 Site 17 - Contaminant Fate and Transport**

The following section summarizes the fate and transport of COCs and TPH detected at Site 17 during the RI and SWMU investigation.

Benzo(a)pyrene, beryllium, and lead are the soil COCs. Benzo(a)pyrene was detected in three surface soil samples collected from the drainage ditch at concentrations that correlate with TPH detections in these samples. The highest detection of benzo(a)pyrene is associated with the highest detection of TPH in soil samples. Benzo(a)pyrene is a principal constituent of TPH. Benzo(a)pyrene has a low mobility in soils and low persistence in storm water. However, benzo(a)pyrene may be transported on soil particles mobilized by storm water runoff in the drainage ditches.

Beryllium and lead will persist at the site because these constituents do not significantly degrade or oxidize over time.

Arsenic and beryllium are the sediment COCs. Both of these metals were detected at concentrations that exceeded their PRGs but were lower than the ambient levels for arsenic and beryllium in soil. Therefore, the concentrations of arsenic and beryllium in sediment appear to be representative of ambient conditions. These metals are persistent in the environment.

TPH-motor oil was detected in six surface soils samples collected from the drainage ditch and in five sediment samples collected from Seal Creek. The TPH-motor oil detected in the drainage ditch may originate from site activities, the asphalt paved areas throughout the site, or from oils associated with the railroad operations adjacent to the drainage ditch. The TPH-motor oil in Seal Creek is likely the a result of discharge from the drainage pipe of the former steam cleaner. The TPH-motor oil may be transported from storm water runoff in the drainage ditches and Seal Creek. TPH-motor oil will eventually biodegrade.

Bis(2-ethylhexyl)phthalate was detected in one of the two rounds of groundwater sampling and is the only COC identified for groundwater. Because the detected concentrations are greater than 50 µg/L, bis(2-ethylhexyl)phthalate is considered to be present in the groundwater samples even though bis(2-ethylhexyl)phthalate was detected at low concentrations in the equipment and laboratory blanks. Some of the bis(2-ethylhexyl)phthalate detected during the first round of sampling may have resulted from new

well construction materials. Bis(2-ethylhexyl)phthalate has low mobility and high persistence in groundwater. However, because it was detected only in the first round of sampling, it is likely that a source of bis(2-ethylhexyl)phthalate does not exist at the site.

As mentioned previously, sediments in Seal Creek are disturbed during winter storm events. It is not known how far from the site they migrate before settling out, but some downstream movement is expected.

#### **13.2.5 Site 17 - Recommendations**

This section presents recommendations for future activities at Site 17. These recommendations are based on a detailed assessment of site physical and chemical data, results from the HHRA and ERA, and evaluation of contaminant fate and transport.

The HHRA and fate and transport analysis of TPH were evaluated using principal constituents of TPH known to have toxicity. The only principal constituent of TPH determined to be a COC at Site 17 was benzo(a)pyrene in soil. Benzo(a)pyrene was detected in three surface soil samples from the drainage ditch at concentrations that correlate with TPH concentrations. TPH was detected sporadically in Site 17 groundwater samples. However, TPH in soil and groundwater is expected to biodegrade with time.

No evidence of the alleged battery acid sump was found and the sump may have never existed. The benzo(a)pyrene and lead detected in the surface samples collected from the drainage ditches may be transported on soil particles mobilized by storm water runoff. The arsenic and beryllium concentrations detected in the soil and sediment samples do not appear to result from site activities, but occur because they are present at ambient levels. The soil COCs are limited to the soil and are not affecting groundwater. The COC in groundwater is not believed to result from site activities. The detection of bis(2-ethylhexyl)phthalate in groundwater samples was not reproducible and was most probably from well materials or laboratory contamination. It is recommended that two additional quarters of groundwater sampling be conducted and the samples be analyzed for SVOCs to confirm that bis(2-ethylhexyl)phthalate is not a continuing problem. Once the sampling is completed, and assuming that bis(2-ethylhexyl)phthalate is not detected, no further action is recommended at this site. The UST at the site should continue to be monitored under the UST program.

The riparian zone of Seal Creek should be managed under the natural resources management plan for the installation.

### **13.3 SITE 22 - BUILDING 7SH5**

The following sections summarize the significant information of the Site 22 chemical characterization, HHRA, and contaminant fate and transport and present recommendations.

#### **13.3.1 Site 22 - Chemical Characterization**

This section summarizes the chemical characterization at Site 22, including the investigation procedures and results.

Soil and groundwater were sampled at Site 22 to evaluate waste activities associated with missile repair and use of a UST. Sampling focused on the areas of a suspected waste pit, an UST fuel line, and the site drainage channels. The site septic system was investigated as part of the SWMU investigation. Soil was sampled by surface grab sampling, Geoprobe borings, and hollow stem auger drilling. Three temporary monitoring wells were installed at the site during the RI, and one round of groundwater sampling was conducted.

No SVOCs or VOCs were detected in soil at concentrations exceeding the residential PRGs. Elevated concentrations of TPH-motor oil and TPH-D were detected in the surface soil sample collected adjacent to the UST fill pipe. TPH-motor oil at lower concentrations was also detected in soil samples collected along the fuel line near the fuel pipe, in the suspected disposal pit, and in the west drainage ditch.

Arsenic was detected in all soil samples collected from the site during the RI and SWMU investigations at concentrations exceeding the residential PRG for this metal; however, no source of arsenic has been identified at the site. Lead was detected at a concentration exceeding the Cal-modified residential PRG in one SWMU investigation sample.

One groundwater sample collected during the RI contained TCE at a concentration of 27 µg/L, which exceeds the PRG. TPH-motor oil was detected in groundwater samples at concentrations ranging from 380 to 630 µg/L. To confirm the presence of the TCE detected, four additional wells were installed in January 1997. Four quarters of groundwater monitoring are currently in progress and the UST and TPH

contaminated soil was removed in January 1997. Once the four quarters of monitoring have been completed, the TCE contamination will be assessed.

### **13.3.2 Site 22 - HHRA**

The objective of the HHRA conducted at Site 22 (Building 7SH5) was to evaluate the potential carcinogenic risks and noncarcinogenic hazards associated with exposure to COPCs in surface soil (0 to 0.5 feet bgs), subsurface soil (0 to 10 feet bgs), and groundwater at the site and to identify COCs. A COC is a risk driver or chemical with a carcinogenic risk greater than  $1 \times 10^{-6}$  or a hazard quotient greater than 1.

NWS Concord is an open naval base and is not scheduled to close. Consequently, based on current land use, Navy personnel are the most likely future receptor. For purposes of this HHRA, activities of base personnel at Site 22 (manufacturing mobile laboratories) were assumed to be similar to an industrial worker. Although very unlikely, it was conservatively assumed that land use may be unrestricted in the future and that residences are constructed at the site. For these reasons, the following receptors were evaluated in the HHRA: an industrial worker and a resident.

The carcinogenic risks and noncarcinogenic hazards were estimated for these receptors by comparing site concentrations of each COPC to EPA Region IX industrial and residential PRGs (EPA 1996). For the industrial worker, the RME carcinogenic risks associated with COPCs in surface soil and subsurface soil are within the target risk range of  $10^{-6}$  and  $10^{-4}$  and the total hazard indices for both soil depth intervals are below the threshold value of 1. Arsenic is the only industrial COC identified at the site.

For a resident, the RME carcinogenic risks for surface soil slightly exceed the target risk range. For subsurface soil, the risks are at the upper limit of the target risk range. The risks can be attributed to arsenic, which was detected in all eight surface soil samples analyzed for this metal at concentrations greater than the ambient arsenic levels established for Site 22. The hazard indices for both soil depth intervals are greater than the threshold value of 1 and can also be attributed to arsenic at the site. The RME carcinogenic risk associated with COPCs in groundwater at Site 22 is within the target risk range and the hazard index is below the threshold value of 1. The risk for groundwater is attributed to a single detection of trichloroethene.

For a resident, the total RME carcinogenic risk attributable to simultaneous exposures to COPCs in soil and groundwater is at the upper limit of the target risk range and the total hazard index is greater than the threshold value of 1. The estimated total risks and hazards for the site can be attributed to arsenic concentrations detected in soil and a single detection of TCE detected in groundwater.

The RME lead concentrations in surface soil and subsurface soil are significantly below the industrial PRGs of 1,000 mg/kg. However, the RME lead concentration in surface soil is slightly above the Cal-modified residential PRG. Only one of 30 samples analyzed for lead contained a lead concentration above the residential PRG. Analyses for lead were not performed on groundwater samples collected from monitoring wells at Site 17.

### **13.3.3 Site 22 – Contaminant Fate and Transport**

The following section summarizes the fate and transport of COCs and TPH detected at Site 22 during the RI and SWMU investigation.

Arsenic and lead are the soil COCs. Arsenic was detected in soil samples from across the site at concentrations exceeding its PRG, while only the samples from the drainage ditch and trench had concentrations greater than its ambient value of 15 mg/kg. The higher than ambient concentrations of arsenic in the drainage ditch sample may be the result of the high clay content of the drainage ditch soil and the deposition of fines during slow storm water flow through the ditches. Clays have a relatively high ion exchange capacity and they are negatively charged, resulting in an affinity for positively charged metal ions. Fine-grained soil has a greater surface area than coarse-grained soil so there is more area for adsorption of metals. Lead was detected in one sample from the drainage ditch at a concentration greater than its residential PRG. Both arsenic and lead are likely to persist on site and may be transported on soil particles mobilized during fast storm water flow through the drainage ditches.

TPH-D and TPH-motor oil were detected in soil samples collected near the UST pipeline, and TPH-motor oil was detected in surface soil samples from the drainage ditch. Both the TPH-D and TPH-motor oil appear to result from leaks associated with the UST pipeline. The TPH-motor oil may be transported off site with storm water runoff through the drainage ditches. TPH-D and TPH-motor oil will eventually biodegrade.

TCE is the only groundwater COC. TCE is a common chlorinated solvent and its presence in groundwater could be from historical site activities, or it could be from an off-site source. TCE has high mobility and is persistent in groundwater. TCE is likely to continue to be transported by groundwater.

TPH-motor oil was detected in all three grab groundwater samples. The TPH-motor oil probably resulted from UST pipeline leaks and spills from the former UST. The TPH-motor oil will migrate in groundwater, but it will biodegrade with time.

#### **13.3.4 Site 22 - Recommendations**

This section presents recommendations for future activities at Site 22. These recommendations are based on a detailed assessment of site physical and chemical data, results from the HHRA, and evaluation of contaminant fate and transport. No ERA was warranted at this site, based on the following factors:

- lack of viable habitat at or adjacent to this site
- limited site use by receptors
- low chemical concentrations

The HHRA and fate and transport analysis of TPH were evaluated using principal constituents of TPH known to have toxicity. No principal constituents of TPH were determined to be COCs at Site 22. TPH was detected in over half of the soil samples and in all three of the groundwater samples collected from Site 22. However, TPH in soil and groundwater is expected to biodegrade with time.

Arsenic and lead were the only soil COCs. Arsenic appears to be from a source other than site activities. The extent of arsenic was not defined at the site, and arsenic is believed to be regionally elevated, as indicated by its ambient concentration being greater than its PRG value. The data indicate that the source of arsenic is not from the site. The arsenic and lead detected in the surface soil samples collected from the drainage ditches may be transported on soil particles mobilized by storm water runoff. No further soil investigation at the site is recommended.

TCE was detected in grab groundwater samples. To substantiate the presence of TCE and to aid in assessment of its source, three monitoring wells were installed in January 1997 and will be sampled for

four quarters (PRC 1996e). A report summarizing these groundwater results is scheduled to be completed in early 1998.

The UST and TPH contaminated soil was removed in January and replaced with an aboveground storage tank under the UST program (HLA 1995).

#### **13.4 SITE 24A - PISTOL FIRING RANGE**

The following sections summarize the significant information of the Site 24A chemical characterization, HHRA, and contaminant fate and transport and present recommendations.

##### **13.4.1 Site 24A - Chemical Characterization**

This section summarizes the chemical characterization at Site 24A, including the investigation procedures and results.

Soil was sampled at Site 24A to assess the nature and extent of metals present as result of past and present site activities. Sampling focused on the firing range target berm and the site drainage channel. Soil was sampled by surface grab sampling and Geoprobe borings.

Concentrations of metals at the site, particularly lead, were generally highest in the soil samples collected from the target berm and the upgradient end of the site drainage channel. Concentrations of metals in target berm samples collected at the soil/bedrock interface were substantially lower than in those collected near the surface.

The metals antimony, arsenic, beryllium, cadmium, and lead were detected at the site in concentrations exceeding the residential PRGs. Lead was detected in 4 soil samples at concentrations exceeding the TTLC (1,000 mg/kg). The majority of the arsenic and beryllium concentrations detected in soil samples are less than their ambient levels in soil. Lead concentrations in the drainage channel diminish significantly with distance from the target berm.

Several SVOCs were detected in the berm samples at concentrations exceeding PRGs and are probably the result of use of creosote-treated timbers at the target berm.

### 13.4.2

#### Site 24A - HHRA

The objective of the HHRA conducted at Site 24A (the Pistol Firing Range) was to evaluate the potential carcinogenic risks and noncarcinogenic hazards associated with exposure to COPCs in surface soil (0 to 0.5 feet bgs) and subsurface soil (0 to 10 feet bgs) at the site and to identify COCs. A COC is a risk driver or chemical with a carcinogenic risk greater than  $1 \times 10^{-6}$  or a hazard quotient greater than 1.

NWS Concord is an open naval base and is not scheduled to close. Consequently, based on current land use, Navy personnel are the most likely future receptor. For purposes of this HHRA, activities of base personnel at Site 24A (the pistol firing range is used for two training events per year) were assumed to be similar to an industrial worker. Although very unlikely, it was conservatively assumed that land use may be unrestricted in the future and that residences are constructed at the site. For these reasons, the following receptors were evaluated in the HHRA: an industrial worker and a resident.

The carcinogenic risks and noncarcinogenic hazards were estimated for these receptors by comparing site concentrations of each COPC to EPA Region IX industrial and residential PRGs (EPA 1996). For the industrial worker, the RME carcinogenic risks associated with COPCs in surface soil and subsurface soil are within the target risk range of  $10^{-6}$  and  $10^{-4}$  and the total hazard indices for both soil depth intervals are below the threshold value of 1. For both depth intervals the risks can be attributed to ambient levels of arsenic. For subsurface soil, PAHs (including benzo(a)pyrene) were also identified as COCs. The risks associated with PAHs at the site were based on the maximum concentrations of these chemicals.

For a resident, the RME carcinogenic risk associated with exposure to COPCs in surface soil is within the target risk range and the risk for subsurface soil slightly exceeds the target risk range. For both depth intervals, the risks can be attributed to ambient levels of arsenic and beryllium. The RME site concentrations of these COCs are below their respective ambient levels established for Site 24 A. For subsurface soil, the risks are also attributable to the maximum concentrations of PAHs detected at the site. The hazard indices for both soil depth intervals are slightly greater than the threshold value of 1. However, no chemical specific hazard quotient exceeds 1.

Five samples in the vicinity of the firing berm and adjacent drainage ditch contain lead concentrations greater than the EPA Region IX industrial soil PRG and eight samples in this area exceed the Cal-



modified residential PRG. However, lead concentrations diminish significantly with distance from the target berm.

#### **13.4.3 Site 24A - Contaminant Fate and Transport**

The COCs in soil are arsenic, beryllium, and lead, and PAHs that include anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h,) anthracene, and indeno(1,2,3-cd)pyrene. The PAHs were detected in two soil samples collected from one soil boring, PFRSB021, which was analyzed for SVOCs because of an organic odor noticed during sampling. The PAHs likely result from the creosote wood preservative on timbers used on site for retaining walls. Creosote has a characteristic sharp odor (Merck 1983). The PAHs have low mobilities and are persistent in storm water. If PAHs are present in surface soil, then they may be transported on soil particles mobilized by storm water runoff in drainage ditches. Arsenic and beryllium are indigenous to site soil. Lead is a result of the bullets present in the site's target berm.

The metals are likely to persist at the site; however, metals tend to bond with clay, which decreases their mobility. Although these metals may bind to the soil, they are also being transported off site by storm water erosion of the soil.

#### **13.4.4 Site 24A - Recommendations**

This section presents recommendations for future activities at Site 24A. These recommendations are based on a detailed assessment of site physical and chemical data, results from the HHRA, and evaluation of contaminant fate and transport. No formal ERA was performed at this site, based on the following factors:

- low habitat value of the site
- rapid attenuation of lead near the site
- active status of firing range

Site 24A is an active site and is no longer part of the IRP. Future environmental work at the site will be conducted by NWS Concord personnel. The PAHs identified as COCs are likely from creosote treated timbers. Metals, specifically lead, are being transported off site via storm water runoff. Engineering

controls, such as a sediment trap, should be added to alter the drainage pattern and minimize the off-site transport of eroded soil containing metals. If PAHs are also present in the drainage ditch soil, then a sediment trap may also mitigate their potential migration off site. NWS Concord should implement BMPs and should amend its SWPP to address the discharges from Site 24A.

### **13.5 SITE 27 - BUILDING 1A-20**

The following sections summarize the significant information of the Site 27 chemical characterization, HHRA, and contaminant fate and transport and present recommendations.

#### **13.5.1 Site 27 - Chemical Characterization**

This section summarizes the chemical characterization at Site 27, including the investigation procedures and results.

Soil was sampled at Site 27 to assess the nature and extent of OC pesticides, PCBs and petroleum hydrocarbons in soils as a result of waste disposal practices and use of a fuel UST. Sampling focused on a drainage swale where waste was reportedly dumped, site building perimeters (including the fuel UST), and the site drainage channel. Soil was sampled by surface grab sampling and Geoprobe borings.

OC pesticides were detected in a number of soil samples collected at the site. Chlordane isomers and 4,4'-DDT were detected in samples collected near the building perimeters at concentrations exceeding PRGs. Pesticide concentrations diminish with distance from the building areas and are not significantly greater in the swale bottom or drainage ditch than in the ambient samples, indicating that pesticides were probably used for surface applications around buildings rather than being disposed of in the swale. Conversely, PCBs were not detected in the building perimeter soil samples, but rather in the other sampling areas including sample collection locations selected to evaluate ambient conditions. PCB concentrations in several of these areas exceeded PRGs.

The spatial distribution of TPH at the site indicates that motor oil range compounds were used for surface applications around buildings, possibly as a weed or dust suppressant, or as a pesticide. Elevated hydrocarbon concentrations near the UST are likely the result of fuel handling. This UST and the accessible contaminated soil surrounding the UST has been removed under the UST removal program at NWS Concord. TPH-motor oil in the drainage swale may be the result of either the motor oil at the site,

from surface runoff from the parking areas and roads near the site. Soils in the swale bottom and area north of Building IA-20 have been relatively unaffected by TPH.

### **13.5.2 Site 27 - HHRA**

The objective of the HHRA conducted at Site 27 (Building IA-20) was to evaluate the potential carcinogenic risks and noncarcinogenic hazards associated with exposure to COPCs in surface soil (0 to 0.5 feet bgs) and subsurface soil (0 to 10 feet bgs) at the site and to identify COCs. A COC is a risk driver or chemical with a carcinogenic risk greater than  $1 \times 10^{-6}$  or a hazard quotient greater than 1.

NWS Concord is an open naval base and is not scheduled to close. Consequently, based on current land use, Navy personnel are the most likely future receptor. For purposes of this HHRA, activities of base personnel at Site 27 (operation and maintenance of the chemical and materials testing laboratories) were assumed to be similar to an industrial worker. Although very unlikely, it was conservatively assumed that land use may be unrestricted in the future and that residences are constructed at the site. For these reasons, the following receptors were evaluated in the HHRA: an industrial worker and a resident.

The carcinogenic risks and noncarcinogenic hazards were estimated for these receptors by comparing site concentrations of each COPC to EPA Region IX industrial and residential PRGs (EPA 1996). For the industrial worker, the RME carcinogenic risks associated with COPCs in surface soil and subsurface soil are within the target risk range of  $10^{-6}$  and  $10^{-4}$ . The hazard index for surface soil is equal to the threshold value of 1.0. For subsurface soil, the hazard index is below 1. Alpha-chlordane and gamma-chlordane are the only industrial COCs identified for Site 27. However, chlordane concentrations exceeded the industrial PRG in only three samples collected around the building foundations.

For a resident, the RME carcinogenic risks for surface soil and subsurface soil are at the upper end of the target risk range. The residential COCs for Site 27 include alpha-chlordane, gamma-chlordane, Aroclor-1248, Aroclor-1254, dieldrin and 4,4'-DDD (surface soil only). For surface soil, the risks associated with alpha-chlordane and gamma-chlordane were based on the maximum concentrations detected at the site. However, the risks associated with the average concentrations of these chemicals are well within the target risk range. The hazard indices for both soil depth intervals are greater than the threshold value of 1 and can also be attributed to chlordane concentrations detected around the building foundations.

### **13.5.3 Site 27 - Contaminant Fate and Transport**

The following section summarizes the fate and transport of COCs and TPH detected at Site 27 during the RI.

The soil COCs are PCBs (Aroclor-1248 and Aroclor-1254) and pesticides (alpha-chlordane, gamma-chlordane, dieldrin, and 4,4'-DDD). These PCBs and pesticides have low mobility and persistent. These PCBs and pesticides were found in the surface soil at the site but not in any of the samples collected at 3 feet bgs. The pesticides are probably from application around the buildings for termite control. The source of the PCBs is not evident. The surface soil containing these COCs may be eroded off site by storm water draining the site.

TPH-D and TPH-motor oil were detected in soil samples collected in the drainage swale. TPH-motor oil was detected in surface soil samples from the drainage ditch and around the buildings. Both the TPH-D and TPH-motor oil detections appear to result from leaks associated with the UST, spills from the use of the UST, or applications of TPH for weed and dust control. The TPH-motor oil may be transported off site with storm water runoff through the drainage channel. TPH-D and TPH-motor oil will eventually biodegrade.

### **13.5.4 Site 27 - Recommendations**

This section presents recommendations for future activities at Site 27. These recommendations are based on a detailed assessment of site physical and chemical data, results from the HHRA, and evaluation of contaminant fate and transport. No ERA was conducted at this site based on the following factors:

- low levels of chemicals detected at the site
- lack of available habitat at or adjacent to the site

The HHRA and fate and transport analysis of TPH were evaluated using principal constituents of TPH known to have toxicity. No principal constituents of TPH were determined to be COCs at Site 27. TPH was detected in 18 of the 19 soil samples collected from Site 27. However, TPH in soil is expected to biodegrade with time.

Pesticides and PCBs were determined to be COCs in soil using a residential scenario, but only chlordane was determined to be a COC in soil using an industrial scenario. Chlordane drives the human health risk at the site. However, when the average concentrations of chlordane are used, the risk falls within the target risk range for both the residential and industrial scenarios. Chlordane concentrations are greatest near the foundation of Building IA-20 and decrease with distance from the building. The chlordane was most likely applied to the ground surface prior to construction of the building. No other source of chlordane is evident at the site. No further action is recommended at Site 27 because the chlordane does not pose a significant human health risk, is only found near the buildings at high concentrations, and is not being transported off site.

## REFERENCES

- Adriano, D.C., editor. 1992. Biogeochemistry of Trace Metals. Lewis Publishers. Boca Raton, Florida.
- Agency for Toxic Substances and Disease Registry (ATSDR). 1995. "Toxicological Profile for Polycyclic Aromatic Hydrocarbons." TP-92/06. August.
- Alloway, B.J. (ed.). 1990. Heavy metals in soils. John Wiley & Sons. New York.
- American Public Health Association (APHA), American Water Works Association, and Water Environmental Federation. 1992. Standards Methods for the Examination of Water and Wastewater (SMEWW), 18th Edition. APHA Publication Office.
- American Society of Testing and Materials (ASTM). 1995a. "Biological Rate and Environmental Effects." Annual Book of ASTM Standards, Water and Environmental Technology. Volume 11.04. Philadelphia, Pennsylvania.
- ASTM. 1995b. "Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites." ASTM Standard E 1739-95.
- Arthur, W.J. and R.J. Gates. 1988. "Trace Element Intake via Soil Ingestion in Pronghorns and Black-tailed Jackrabbits." Journal of Range Management. Volume 41. Pages 162-166.
- Anderson Geotechnical Consultants, Inc. (AG) and Brown and Caldwell Consulting Engineers (B&C). 1984. "Draft Confirmation Study Report, NWS Concord," Department of the Navy, Naval Facilities Engineering Command, San Bruno, California.
- Bell, R.M. and R.A. Failey. 1991. "Plant Uptake of Organic Pollutants." In Organic Contaminants in the Environment. Jones, K.C., editor. Elsevier Applied Science. New York, New York.
- Bergman, H.L. and others. 1986. Environmental Hazard Assessment of Effluents. Pergamon Press. New York.
- Beyer, W.N., E.E. Connor, and S. Gerould. 1994. "Estimates of Soil Ingestion by Wildlife." Journal of Wildlife Management. Volume 58. Pages 375-382.
- Bolt, G.H. and M.G.M. Breggenwert. 1978. "Soil Chemistry, Volume A. Basic Elements." Elsevier Pub., Amersteram, Neth. p. 281.
- Brown & Caldwell, Inc. (B&C). 1986. "Kinne Boulevard Wells Sampling Program, Naval Weapons Station, Concord, California," Western Division Naval Facilities Engineering Command, San Bruno, California.
- Burkhard, L.P., D.E. Armstrong, and A.W. Andren. 1985. Henry's law constants for the polychlorinated biphenyls. Environ. Sci. Technol. 19:590-596.
- California Department of Fish and Game (CDFG). 1994. "Species of Special Concern." August

- California Department of Toxic Substances Control (DTSC). 1994a. "Guidance for Ecological Risk Assessment at Hazardous Waste Sites and Permitted Facilities, Draft." August.
- DTSC. 1994b. Memorandum Regarding Recommended Outline for Using U.S. Environmental Protection Agency Region IX Preliminary Remediation Goals in Screening Risk Assessments at Military Facilities. From DTSC Toxicologists, To the Office of Military Facilities. October 28.
- DTSC. 1994c. Preliminary Endangerment Assessment Guidance Manual, California Department of Toxic Substances Control. January 1994.
- California Environmental Protection Agency (Cal/EPA). 1993. Memorandum Regarding Policy for the Evaluation of Risk from Total Petroleum Hydrocarbons (TPH) at a Hazardous Waste Site. From TPH Task Group, Office of Scientific Affairs, and DTSC. To DTSC Toxicologists. April 26.
- Cal/EPA. 1994. Memorandum Regarding Cancer Potency Factors; Update. From Standards and Criteria Work Group, OEHHA. To Cal/EPA Departments, Boards, and Office. November 1.
- California Department of Conservation, Division of Mines and Geology, 1992.
- California Department of Water Resources (CDWR). 1983. "The California Water Plan: Projected Use and Available Water Supplies to 2010." Bull. California Department of Water Resources. Volume 160-83. 268 pp.
- CDWR. 1987. "Water Quality in the Sacramento - San Joaquin Delta During 1986."
- CDWR. 1988. "Hydrologic Data 1985 - Volume III: Central Coastal Area." Bulletin 130-85.
- California Regional Water Quality Control Board - San Francisco Bay Region. 1996. Water Quality Control Plan: San Francisco Bay Region (Region 2).
- California State Water Resources Control Board, 1989. "Leaking Underground Fuel Tank Field Manual: Guidance for Site Assessment, Cleanup, and Underground Storage Tank Closure." October.
- Callahan, M.A., M.W. Slimak, N.W. Gabel, I.P. May, J.R. Fowler, P. Jennings, R.L. Durfee, F.C. Whitmore, B. Maestri, W.R. Mabey, B.R. Holt, and C. Gould. 1979. Water-related environmental fate of 129 priority pollutants, Vol. I and II. Report No. EPA-440/4-79-029a and -029b. Washington, D.C. U.S. Environmental Protection Agency, Office of Water Planning and Standards.
- Clayton, G.D. and F.E. Clayton, eds. 1981. Patty's Industrial Hygiene and Toxicology, 3rd rev. ed., Vol. 2A, 2B, Toxicology. John Wiley and Sons, Inc. New York.
- Cummings, E., Contra Costa County Water District. 1996. Personal communication to Yvonne Leung, Montgomery Watson, Walnut Creek, California. June.
- Davies, B.E. 1990. "Lead." Heavy metals in soil. B.J. Alloway (ed.). Blackie/John Wiley & Sons. New York. pp. 177-196.
- Dibblee, T.W., Jr. 1980a. "Preliminary Geologic Map of the Clayton Quadrangle, Contra Costa County, California." Open File Report 80-547. U.S. Geological Survey.

- Dibblee, T.W., Jr. 1980b. "Preliminary Geologic Map of the Honker Bay Quadrangle, Solano and Contra Costa Counties, California." Open File Report 802009. U.S. Geological Survey.
- Dibblee, T.W., Jr. 1980c. "Preliminary Geological Map of the Walnut Creek Quadrangle, Contra Costa County, California." Open File Report 80-351. U.S. Geological Survey.
- Dibblee, T.W., Jr. 1981. "Preliminary Geologic Map of the Port Chicago Quadrangle, Solano and Contra Costa Counties, California." Open File Report 81-108. U.S. Geological Survey.
- Dickson, K.L. and others. 1979. Analyzing the Hazard Evaluation Process. American Fisheries Society, Water Quality Section. Washington, D.C.
- Dickson, K.L. and others. 1987. Fate of Sediment-Bound Chemicals in Aquatic Systems. Pergamon Press. New York, New York.
- Diehl, D. EODMV Nine DET Concord. 1992. Personal communication to Richard Baldwin, James M. Montgomery Consulting Engineers, Inc. Walnut Creek, California.
- Dragun, J. 1988. "The Soil Chemistry of Hazardous Materials. Hazardous Materials Control Research Institute." Silver Springs, Maryland.
- Ecology and Environment, Inc. (E&E). 1983. "Initial Assessment Study of Naval Weapons Station, Concord, California." NEESA 13-013, Naval Energy and Environmental Support Activity. Port Hueneme, California.
- EDAC. Undated. "Rapid Seismic Analysis of Structures at NWS Concord California." Western Division Naval Facilities Command, San Bruno, California.
- Eisler, R. 1987. Mercury hazards to fish, wildlife, and invertebrates: A synoptic review. Biological Report 85(1.10). April 1987. U.S. Fish and Wildlife Service, Department of the Interior, Washington, D.C.
- ERM-West. 1989. "1988 Precision Tank Testing, Concord Naval Weapons Station." ERM-West, Rancho Cordova, California.
- Evans, S., Public Works Department, WPNSTA Concord. 1992. Personal Communication to Richard Baldwin, James M. Montgomery, Consulting Engineers, Inc., Walnut Creek, California.
- Fetter, C.W. 1993. Contaminant Hydrogeology. MacMillan Publishing Company. New York.
- Geyer, H., P. Sheehan, D. Kotzias, D. Freitag, and F. Korte. 1982. Prediction of ecotoxicological behavior of chemicals. Relationship between physico-chemical properties and bioaccumulation of organic chemicals in the mussel, *Mytilus edulis* Chemosphere 11:1121-1134.
- Griffin, R.A. and E.S.K. Chian. 1980. Attenuation of water-soluble polychlorinated biphenyls by earth materials. EPA 600/2-80-027. Cincinnati, Ohio. U.S. Environmental Protection Agency, NTIS PB80-219652.
- Groundwater Technology, Inc. (GTI). 1991. "Closure Report - Soil Excavation and Site Restoration Unocal Pipeline, Concord Naval Weapons Station, Unocal Refining and Marketing Division."



- Harding Lawson Associates (HLA). 1995. "Final Submittal Contract N62474-91-D-9582, Phase I and II Subsurface Investigation and Tank Removal Plan, Concord Naval Weapons Station, Concord, California." January.
- Hart, E.W. 1993. Personal Communication between Earl W. Hart of the California Division of Mines and Geology and Andrew Kerr of JMM. October 12.
- Hawley, G.G., ed. 1981. The Condensed Chemical Dictionary, 10th ed. Van Nostrand. New York.
- Hcm, J.D. 1989. "Study and Interpretation of the Chemical Characteristics of Natural Water." U.S. Geological Survey Water Supply Paper 2254. 3rd Edition. p. 263.
- Hickman, J.C., editor. 1993. The Jepson Manual : Higher Plants of California. University of California Press. Berkeley.
- Howard, P.H. and others. 1990. "Handbook of Environmental Fate and Exposure Data For Organic Chemicals." Lewis Publishers, Chelsea, Michigan.
- International Technology Corporation (IT Corp.). 1989. "Draft Final Work Plan for Remedial Investigation at Naval Weapons Station Concord, California, Inland Area Sites," Volumes I, II, III, IV, and V.
- IT Corp. 1990. "Site Investigation at Building IA-25 Naval Weapons Station, Concord, California."
- IT Corp. 1991. "Removal and Closure of 16 Underground Fuel Tanks at Naval Weapons Station Concord, California."
- Jones and Stokes. 1982. "A Natural Resources Survey (NRS), Naval Weapons Station Concord, California."
- K.T.W. & Associates, Inc. 1997. "Summary of Excavation and Sampling Activities at Site IA36, Contract N62474-94-C-7515, Repair/Replace Underground Fuel Storage Tanks, Naval Weapons Station, Concord, California." June 19
- Kabata-Pendias, A and H. Pendias. 1992. Trace Elements in Soils and Plants, 2nd Edition. Lewis Publishers. Boca Raton, Florida.
- Kadeg, R.D., S.P. Pavlou, and A.S. Duxbury. 1986. Elaboration of sediment normalization theory for nonpolar hydrophobic organic chemicals. EPA Criteria and Standards Division, Washington, D.C.
- Lake, D. 1995. Unusual and Significant Plants of Alameda and Contra Costa Counties, 4th edition. California Native Plant Society, East Bay Chapter.
- Lee, C. R. et al. 1986. "Remedial Investigation of Contaminant Mobility at Naval Weapons Station, Concord, California." Miscellaneous Paper EL-86-2. U.S. Army Engineer Waterways Experiment Station. Vicksburg, Mississippi.

- Lco, A. 1983. Log P and parameter database Issue No. 24 (dated December 16, 1983) prepared by the Medchem Project, Pomona College, Claremont, California (Available from Technical Database Services, Inc., New York, New York).
- Lincoln, R.J., G.A. Boxshall, and P.F. Clark. 1982. *A Dictionary of Ecology, Evolution, and Systematics*. Cambridge University Press, Cambridge.
- Linder, G., Bollman, M., Gillett, C., King, R., Nwosu, J., Ott, S., Wilborn, D., Henderson, G., Pflieger, T., Darrow, T., and Lightfoot, D. 1994a. The role of preliminary field and laboratory studies for ecological risk assessments in wetland and terrestrial habitats: two case studies. In *Environmental Toxicology and Risk Assessment - Third Volume*, ASTM STP 1218, Jane S. Hughes, Gregory R. Biddinger, and Eugene Mones, Eds., American Society for Testing and Materials, Philadelphia. pp. 61-78.
- Linder, G., R. Hazelwood, D. Palawski, M. Bollman, D. Wilborn, J. Malloy, K. DuBois, S. Ott, G. Pascoe, and J. DalSoglio. 1994b. Ecological assessment for the wetlands at Milltown Reservoir, Missoula, Montana: Characterization of emergent and upland plants. *Environ. Toxicol. Chem.* 1957-1970.
- Linder, G., G. Henderson, and E. Ingham. 1996a. Metal toxicity in the rhizosphere. Part One: Soil ecology and revegetation of disturbed mining lands of the western United States. *Hortus West*. 7(1):6-10;38-51.
- Linder, G., G. Henderson, and G. Pascoe. 1996b. Metal toxicity in the rhizosphere. Part Two: Improving soil tilth and plant nutrition to enhance revegetation of disturbed mining lands of the western United States. *Hortus West*. 7(2):6-9; 50-58
- Long, E.R. and L.G. Morgan. 1990. "The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program." NOS OMA 52. U.S. National Oceanic and Atmospheric Administration, Seattle, Washington.
- Long, E.R., D.D. MacDonald, S.L. Smith, and F.D. Calder. 1995. "Incidence of Adverse Biological Effects Within Ranges of Chemical Concentrations in Marine and Estuarine Sediments." *Environmental Management*. Volume 19, Number 1. Pages 81-97.
- Lutton, R.J., R.D. Bennett, C.C. McAneny, and D.N. Wong. 1987. "Suitability for Sites for Hazardous Waste Disposal, Concord Naval Weapons Station, Concord, California." Miscellaneous Paper GL-87-28. U.S. Army Engineer Waterways Experiment Station Geotechnical Laboratory. Vicksburg, Mississippi.
- Lyman, W.J., W.F. Reehl, and D.H. Rosenblatt. 1990. *Handbook of Chemical Property Estimation Methods*. American Chemical Society, Washington, D.C.
- Mabey, W.R., J.H. Smith, R.D. Podoll, J.L. Johnson, T. Mill, T.W. Chou, J. Gates, and I. Waight-Partridge. 1981. Aquatic fate process data for organic priority pollutants. Washington, D.C. U.S. Environmental Protection Agency, Office of Water Regulations and Standards, Monitoring and Data Support Division.

- Mackison, F.W., R.S. Stricoff, and L.J. Partridge, Jr. 1981. NIOSH/OSHA Occupational Health Guidelines for Chemical Hazards. Washington. U.S. G.P.O. DHHS (NIOSH) Publication No. 81-123.
- MacDonald, D.D. 1993. "Development of an approach to the assessment of sediment quality in Florida coastal waters." Florida Department of Environmental Regulation, Tallahassee, Florida, Vol. 1.
- Marschner, H. 1986. Mineral nutrition of higher plants. Academic Press, Inc. New York.
- Massachusetts Department of Environmental Quality, Bureau of Waste Site Cleanup. 1994. Interim Final Petroleum Report: Development of Health-Based Alternative to the Total Petroleum Hydrocarbon (TPH) Parameter. August.
- Merck & Co., Inc. 1983. The Merck Index, Tenth Edition. Merck & Co., Inc. Rahway, New Jersey.
- Mitra, J., V. Ramachandran, and A.S. Nirale. 1991. "Effects of DDT on Plant Mineral Nutrition." Environmental Pollution. Volume 70. Pages 71-80.
- Montgomery, J.H. and L.M. Welkom. 1991. "Groundwater Chemicals Desk Reference." Lewis Publishers. Chelsea, Michigan.
- Munshower, F. 1994. Practical handbook of disturbed land revegetation. Lewis Publishers, Inc. Boca
- National Oceanic and Atmospheric Administration (NOAA). 1991. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. Technical Memorandum Number OMA 52. NOAA, Office of Oceanography and Marine Assessment. Seattle, Washington.
- Naval Energy and Environment Support Activity (NEESA). 1988. "Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program." Prepared by Martin Marietta Energy Systems, Inc. Second Revision.
- Naval Facilities Engineering Command (NFEC). Undated. "Environmental Assessment, Ammunition Pier (Containers) Convert Pier 2, First INCR (P-161) WPNSTA Concord."
- NFEC. 1979. "Master Plan, Naval Weapons Station, Concord, California." Naval Facilities Engineering Command Headquarters, Washington D.C.
- Nelson, T. 1993. Personal communication between Todd Nelson, former geologist for Contra Costa County, and Andrew Kerr of JMM. October 12.
- Oak Ridge National Laboratories (ORNL). 1989. Installation Restoration Program Toxicology Guide. Volumes 1-4. Biomedical and Environmental Information Analysis, Health and Safety Research Division of Oakridge National Laboratory in Oakridge, Tennessee. July.
- Olson, B.L. 1994. Status of Rare, Threatened and Endangered Vascular Plants in Alameda and Contra Costa Counties, 3rd edition. California Native Plant Society, East Bay Chapter.

- Pascoe, G.A. and J.A. DalSoglio. 1994a. Planning and implementation of a comprehensive ecological risk assessment at the Milltown Reservoir-Clark Fork River Superfund Site, MT. *Environmental Toxicology and Chemistry*. 13:1943-1956.
- Pascoe, G.A. and others. 1994b. Bioavailability of metals and arsenic to small mammals at a mining waste-contaminated wetland. *Archives of Environmental Toxicology and Chemistry*. Volume 27. Pages 44-50.
- Pascoe, G.A., R.J. Blanchet, and G. Linder. 1996. "Food Chain Analysis of Exposures and Risks to Wildlife at a Metals Contaminated Wetland." *Archives of Environmental Contamination and Toxicology*. Volume 30. Pages 306-318.
- Pastorok, R.A., M.K. Butcher, and R.D. Nielsen. 1996. Modeling wildlife exposure to toxic chemicals: Trends and recent advances. *Human & Ecological Risk Assess.* In Press.
- Persuad, D., R. Jaagumagi, and A. Hayton. 1992. "Guidelines for the Protection and Management of Aquatic Sediment Quality in Ontario." ISBN 0-7729-9248-7. Ontario Ministry of the Environment, Toronto, Canada.
- Powers, S.E. and others. 1991. "Theoretical Study of the Significance of Nonaqueous Phase Liquids in Subsurface Systems." *Water Resources Research*, Volume 27, No. 4, p. 463-477.
- PRC Environmental Management, Inc. (PRC). 1990. "Comprehensive Long-Term Environmental Action Navy Quality Control Management Plan." January.
- PRC. 1993a. "Hydrocarbon Site Investigation Report, Remedial Action Subsite 3, Draft Summary Report, Naval Weapons Station Concord, California." November.
- PRC. 1993b. "Remedial Investigation/Feasibility Study, Tidal Area Sites, Qualitative Ecological Assessment, Interim Site Description Report, Naval Weapons Station Concord, California." May.
- PRC. 1993c. "Remedial Investigation/Feasibility Study, Tidal Area Sites, Work Plan, Volume II, Qualitative Ecological Assessment, Draft, Naval Weapons Station Concord, California." September.
- PRC. 1993d. "Naval Weapons Station Concord, Site Investigation Report, Inland Area Sites, Draft."
- PRC. 1994. Final Revised Well Closure Field Work Plan, Kinne Boulevard Wells, Inland Area, Naval Weapons Station, Concord, California. May 19.
- PRC. 1995a. "Waste Management Plan, Remedial Investigation/Feasibility Study Inland Area Sites, Naval Weapons Station, Concord, California."
- PRC. 1995b. "Community Relations Plan, Remedial Investigation/Feasibility Study Inland Area Sites, Naval Weapons Station, Concord, California."
- PRC. 1996a. Tidal Area RI Report.

- PRC. 1996b. "Revised Human Health Risk Assessment Approach, Naval Weapons Station Concord, California." February.
- PRC. 1996c. Record of Electronic Mail Communication Regarding Information Needs for the Inland Area Sites. Between Julianne Howe, Environmental Scientist, and Rich Pieper, Naval Weapons Station, Concord. May 3.
- PRC. 1996d. After Remediation (Year 1) Remedial Action Monitoring Report, Volume 1. Litigation Area, Naval Weapons Station, Concord. May 31.
- PRC. 1996e. Draft Report, RCRA Facility Assessment Confirmation Study, Naval Weapons Station Concord, California. July 3.
- PRC. 1996f. Draft Work Plan, Phase II RI/FS, Naval Weapons Station Concord, California. August.
- PRC. 1997. "Development of Toxicity Reference Values as Part of a Regional Approach for Conducting Ecological Risk Assessments at Naval Facilities in California". June.
- PRC/James M. Montgomery, Inc. (JMM). 1992a. "Naval Weapons Station Concord, Site Investigation Inland Area Sites, Volume I: Work Plan, Final."
- PRC/JMM. 1992b. "Naval Weapons Station Concord, Site Investigation Inland Area Sites Volume II: Sampling Plan, Final."
- PRC/JMM. 1992c. "Naval Weapons Station Concord, Site Investigation Inland Area Sites, Volume III: Quality Assurance Project Plan, Final."
- PRC/JMM. 1992d. "Naval Weapons Station Concord, Site Investigation Inland Area Sites, Volume IV: Health and Safety Plan, Final."
- PRC/Montgomery Watson. 1993a. "Naval Weapons Station Concord, Site Investigation Report, Inland Area Sites, Draft." March.
- PRC/Montgomery Watson. 1993b. "Storm Water Pollution Prevention Plan, Naval Weapons Station, Concord, California." March 29.
- PRC/Montgomery Watson. 1995a. "Remedial Investigation/Feasibility Study, Inland Area Sites, Work Plan, Draft Final." February 3.
- PRC/Montgomery Watson. 1995b. "Remedial Investigation/Feasibility Study, Inland Area Sites, Field Sampling Plan, Draft Final." February 3.
- PRC/Montgomery Watson. 1995c. "Draft Final Quality Assurance Project Plan, Remedial Investigation/Feasibility Study Inland Area Sites, Naval Weapons Station, Concord, California." February 15.
- PRC/Montgomery Watson. 1995d. "Health and Safety Plan, Remedial Investigation/Feasibility Study Inland Area Sites, Naval Weapons Station, Concord, California." February 3.

- Reid, R.C., J.M. Prausnitz, and T.K. Sherwood. 1977. *The Properties of Gases and Liquids*, 3rd ed. McGraw-Hill Book Co. New York.
- Rice, D.W., B.P. Doohar, S.J. Cullen, L.G. Everett, W.E. Kostenberg, R.D. Grose, and M.A. Marino. 1995. "Recommendations to Improve the Cleanup Process for California's Leaking Underground Fuel Tanks." Lawrence Livermore National Laboratory and University of California. Livermore, California. October 16.
- Rao, P.S.C. et al. 1980. Solute Transport in Aggregated Porous Media: Theoretical and Experimental Evaluation. *Soil Science Society of America Journal*. 48:3-6.
- San Francisco Regional Water Quality Control Board (RWQCB). 1995. Contaminant Levels in Fish Tissue from San Francisco Bay, Final Report. June.
- Schwille, F. 1988. "Dense Chlorinated Solvents in Porous and Fractured Media: Model Experiments." Lewis Publishers. Chelsea, Michigan.
- Skinner, M.W. 1994. California Native Plant Society's Inventory of Rare and Endangered Vascular Plants of California, 5th edition. Number 1. California Native Plant Society. Sacramento.
- Smith J.P. and K. Berg. 1988. Inventory of rare and endangered vascular plants of California, 4th edition. Number 1. California Native Plant Society. Sacramento.
- Sparling, D.W. and T.P. Lowe. 1996. "Environmental Hazards of Aluminum to Plants, Invertebrates, Fish, and Wildlife." *Reviews of Environmental Contamination and Toxicology*. Volume 145. Pages 1-127.
- Suedel, B.C. and J.A. Boraczek, R.K. Peddicord, P.A. Clifford, T. M. Dillon. 1994. "Trophic Transfer and Biomagnification Potential of Contaminants in Aquatic Ecosystems". *Reviews of Environmental Contamination and Toxicology*. Volume 136. Pages 21-89.
- Suter, G.W. II. 1990. Endpoints for Regional Ecological Risk Assessments. *Environmental Management*. Volume 14. Pages 9 to 23.
- Suter, G.W. II. 1993. *Ecological Risk Assessment*. Lewis Publishers, Ann Arbor, Michigan.
- Tiebout, H.M. and K.E. Brugger. 1995. Ecological risk assessment of pesticides for terrestrial vertebrates: Evaluation and application of the U.S. Environmental Protection Agency's Quotient Model. *Conserv. Biol.* 9:1605-1618.
- Urban, D.J and N.J. Cook. 1986. Hazard evaluation division standard evaluation procedure: Ecological risk assessment. EPA/540/9-85/001. Office of Pesticide Programs, U.S. Environmental Protection Agency, Washington, DC.
- U.S. Coast Guard. 1978. CHRIS Hazardous Chemical Data Report No. M16465.12 COMDINST. Washington, D.C. Department of Transportation, U.S. Coast Guard. (Available US G.P.O. Stock No. 050-012-00147-2).
- U.S. Environmental Protection Agency (EPA). 1982. "Aquatic Fate Process Data for Organic Priority Pollutants." Final. EPA/440/4-81-014. December.

- EPA. 1983. "Methods for Chemical Analysis of Water and Wastes." March.
- EPA. 1986. "SW-846. EPA Test Methods for Evaluating Solid Waste." (Including updates through 1990).
- EPA. 1987. "Data Quality Objectives for Remedial Response Activities Development Process."
- EPA. 1988. "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA." Interim Final. EPA/540G-89/004. October.
- EPA. 1989a. "Ecological Assessment of Hazardous Waste Sites: A Field and Laboratory Reference." EPA/600/3-89/013. March.
- EPA. 1989b. Risk Assessment Guidance for Superfund, Vol. II, Environmental Evaluation Manual, Interim Final. EPA/540/1-89/001. March.
- EPA. 1989c. "The Nature and Extent of Ecological Risks at Superfund Sites and RCRA Facilities." EPA/230/03-89-043. July
- EPA. 1989d. "Risk Assessment Guidance for Superfund, Volume 1, Human Health Evaluation." EPA/540/1-89/002. December.
- EPA. 1990a. National Oil and Hazardous Substances Pollution Contingency Plan: Final Rule, 40 Code of Federal Regulations Part 300. Federal Register. March 8.
- EPA. 1990b. "Guidance for Data Useability in Risk Assessment." Interim Final. EPA/540/G-90/008. October.
- EPA. 1991a. "Risk Assessment Guidance for Superfund (RAGS): Volume I -- Human Health Evaluation Manual, Part B, Development of Risk-based Preliminary Remediation Goals." Interim Final. December.
- EPA. 1991b. "Risk Assessment Guidance for Superfund. Vol. I: Human Health Evaluation Manual, Part A Supplemental Guidance: "Standard Default Exposure Factors." Office of Emergency and Remedial Response. OSWER 9285.6-03.
- EPA. 1992a. Framework for Ecological Risk Assessment. EPA/630/R-92/001. February.
- EPA. 1992b. Guidance for Data Useability in Risk Assessment (Part A). Publication 9285.7-09A. Office of Emergency and Remedial Response, Washington, D.C. PB-92-963356. April.
- EPA. 1992c. "Supplemental Guidance to RAGS: Calculating the Concentration Term." Publication 9285.7-081. May.
- EPA. 1992d. "Quality Criteria for Water." U.S. Environmental Protection Agency, Office of Water, Washington, D.C.
- EPA. 1993a. "Data Quality Objectives Process for Superfund." Interim Final Guidance. Office of Emergency and Remedial Response. September.

- US EPA. 1993 b,c. Wildlife exposure factors handbook. Vol. I and II. U.S. Environmental Protection Agency. Office of Research and Development. Washington, D.C. EPA/600/R-93/187a,b.
- EPA. 1993d. "Statement of Work for Organic Analysis." CLP Document No. ILM03.0.
- EPA. 1993e. "Statement of Work for Inorganic Analysis." CLP Document No. OLM02.1.
- EPA. 1994a. "USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review." Office of Solid Waste and Emergency Response. EPA-540/R-94-013. February.
- EPA. 1994b. "USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review." Office of Solid Waste and Emergency Response. EPA-540/R-94-012. February.
- EPA. 1995. Health Effects Assessment Summary Tables, Office of Research and Development.
- EPA. 1996a. Integrated Risk Information System Online Database. U.S. Environmental Protection Agency.
- EPA. 1996b. Memorandum Regarding Region IX Preliminary Remediation Goals (PRGs). From Stanford J. Smucker, Regional Toxicologist, to PRG Table Mailing List. August 1.
- EPA. 1996c. PCBs: Cancer Dose-Response Assessment and Application to Environmental Mixtures. EPA/600-96/001F. September.
- EPA. 1996d. Soil Screening Guidance: Technical Background Document. EPA/540/R-95/128. Office of Emergency and Remedial Response, Washington, D.C. PB96-963502. May.
- Verma, A. and M.K.K. Pillai. 1991. "Bioavailability of Soil-Bound Residues of DDT and HCH to Certain Plants." Soil Biology and Biochemistry. Volume 23, Number 4. Pages 347-351.
- Verschuieren, K. 1983. Handbook of Environmental Data on Organic Chemicals. Van Nostrand. New York.
- Will, M.E. and G.W. Suter II. 1995a. Toxicological benchmarks for potential contaminants of concern for effects on soil and litter invertebrates and heterotrophic process. Oak Ridge National Laboratory, Oak Ridge TN. ES/ER/TM
- Will, M.E. and G.W. Suter II. 1995b. Toxicological benchmarks for screening potential contaminants of concern for effects on terrestrial plants: 1995 revision. Oak Ridge National Laboratory, Oak Ridge, TN. ES/ER/TM-85/R2.
- Wolfe, N.L., W.C. Steen, and L.A. Burns. 1980. Phthalate ester hydrolysis. Linear free energy relationships. Chemosphere 9:403-408.
- Wren, C.D., S. Harris, and N. Hartup. 1995. Ecotoxicology of mercury and cadmium. In Handbook of Ecotoxicology. D.J. Hoffman, B.A. Rattner, G.A. Burton, and J. Cairns, Jr. (eds.). Lewis Publishers, Inc. Boca Raton, FL. pp. 392 - 423.
- Zar, J.H. 1986. Biostatistical Analysis. Prentice-Hall, Inc., Englewood Cliffs, NJ.



